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ETHNOLOGY.—*Utilization of animals and plants by the Malecite Indians of New Brunswick.* FRANK G. SPECK, University of Pennsylvania, and RALPH W. DEXTER, Kent State University. (Communicated by John C. Ewers.)

An earlier paper (Speck and Dexter, 1951) described the utilization of animals and plants by the Micmac Indians of New Brunswick. The present report is a continuation of the same project in ethnoecology carried out in the summer of 1949 shortly before the death of Dr. Speck. Reference should be made to the previous publication for an explanation of this field study and the conditions under which these reports were prepared. Acknowledgment is again made to all those mentioned earlier in making it possible for the junior writer to complete these studies.

While traveling in Maine in September in 1949, we visited the Indian colony on Indian Island at Old Town. Several families, well known to Dr. Speck over many years time, were revisited. Information on our food investigation of the Eastern Woodland Indians was gathered largely from three members of the Malecite tribe who had formerly lived on the Malecite reservations of the St. John River Valley. They were Gabe Polchis, aged 65, who was born and raised in a wigwam on the banks of the St. John River in New Brunswick, and two younger men, Paul Sappier and Charles R. Paul. These informants, to whom we are greatly indebted, are familiar with the hunting and fishing activities and the utilization of natural resources in the St. John Valley. Again in this investigation, special attention was directed toward the use of native animals and plants for food or food procurement, with incidental attention to other multiple uses of these food resources. As before, an attempt has been made to synthesize original and published knowledge of an archeological, ethnological, and biological nature so as to present an overview of the relations of these surviving aborigines to their natural environment. Like the Micmac and other groups of the Northeastern Indians, the Malecite lived largely on the harvest of wild resources. Many of their native practices have come down to the present day, in modified form, and others are still in the memory of the older Indians. Animals and their capture, especially, oriented the lives of these neolithic people who sought them for food, medicine, clothing, housing, and utensils. Animal life also forms the basis for much of their art, religion, folklore, and social organization.

Because Dr. Speck had previously learned or recorded many of the Malecite names for animals and plants on earlier field trips, only a few were taken down during this last one. Those are given in the text. It is unfortunate that our original intention of preparing a complete table of Malecite terms cannot be fulfilled. Transcriptions of Dr. Speck's linguistic notes were made by John Witthoft.—R.W.D.

THE MALECITE INDIANS OF THE ST. JOHN RIVER VALLEY

In the valley of the St. John River there has long lived a group of American aborigines known as the Malecite. Early accounts designated these people as Etchemin or Maliseet. Those dwelling near the coast, with a somewhat different culture, have been given the special name of Passamaquoddy. They lived much like their neighbors, the Micmac of eastern New Brunswick and coastal Nova Scotia, which have been treated in the earlier report. The main

group of Malecite, however, have been river-bank dwellers, occupying the boundary between the Province of New Brunswick and the State of Maine. Chamberlain (1904) has offered a suggestion, not accepted by all, that the Malecite were an offshoot from the Penobscot tribe of Maine, which migrated northward and settled on the inland waters of northern Maine and western New Brunswick, especially along the St. John River. Here they called themselves "Wulastuk-wink," meaning "dwellers on the beautiful river." Today there still remain six reservations for these people along the St. John River at Oromocto, Devin (St. Mary), Kingsclear, Woodstock, Tobique Point, and Edmunston, named in order going upstream, where fishing and basket weaving are still the chief occupations. Our informants have visited or lived on all these reservations except the last two. In recent times there has been frequent intermarriage between the Malecite and Penobscot with a resulting fusion of their cultures. The Penobscot tribe has been monographed by Speck (1940).

Prehistoric culture of the Malecite, especially the coastal Passamaquoddy, has been the subject of archeological papers by Treat (1836), Baird (1882), Matthew (1884), Bailey (1887), and McIntosh (1909). Ethnological studies in this region by Maillard (1758), Barratt (1851), Flannery (1939, 1946), and Cooper (1946) have included information on protohistoric Malecite culture. Perhaps the best-known aspect of this culture is the folklore, much of which has been published by Jack (1895), Chamberlain (1898), Watson (1907), Mechling (1913, 1914), Stamp (1915), and Speck (1917). Just as in the case of the Micmac, animal life was the dominant theme of Malecite economic and social life. However, only the Passamaquoddy branch shared the dependency on marine resources which were so vital to the Micmac and other coastal tribes. Wissler (1924) has observed that "when a mode of culture evolves anywhere, it grows up around some natural resource and tends to spread to the distribution limits of that resource." The inland Malecite of the St. John Valley depended more upon fresh-water fishes, the birds and mammals of the river bottomland, and upland game. They also developed agriculture to a greater degree. After contact with the white man, hunting gradually diminished and maize cultivation became of increasing importance. This led to even more of a sedentary existence. There is some evidence, however, that members of the inland bands at one time journeyed to the coast on the Bay of Fundy during the summer season to obtain shellfish and marine fishes, a portion of which was preserved and carried back for winter use.

Published records of shell heaps list the following marine animals which were gathered by the inhabitants and seasonal visitors along the coast line of southern New Brunswick:

Pecten grandis—Giant scallop
Modiolus modiolus—Horse mussel
Mytilus edulis—Blue mussel
Mya arenaria—Soft-shell clam
Polinices heros—Sand-collar snail
Crepidula fornicata—Boat shell
Thais lapillus—Rock snail
Buccinum undatum—Whelk
Echinoidea—Sea-urchins
Clupea harengus—Herring
Cottidae—Sculpins
Gadus morhua—Cod
Elasmobranchii—Sharks
Sea birds of various species

Undoubtedly this listing is very incomplete. Several small species of shells have also been reported, but they probably reached the refuse heaps accidentally. Land snails reported may have been hidden there by shrews as part of their storing activities, as similar finds in shell heaps of Massachusetts were explained by Speck and Dexter (1948). The occurrence of large quantities of the tests and spines of sea-urchins as found by Baird (1882) is unusual. Very little evidence is known for the utilization of these echinoderms on the North American coast except in the Aleutian Islands and adjacent areas where they were often the predominant food resource. Loomis and Young (1912) likewise reported sea-urchins from shell heaps they studied on the coast of Maine. Matthew (1884) raised the question that a sea-urchin found by him in an excavation may have been accidentally dropped there by a crow (or possibly by a gull?—author). Loomis and Young (ibid.) thought some of the snails they found might also have reached the shell heaps in the same way. Since the sea-urchins found by Baird were in one large mass in a single mound, they

may have served as an emergency food over a short period of time or advantage may have been taken of this animal form, commonly eaten in southern Europe, at a time when it was particularly abundant or easy to gather. Baird stated that they were cooked by being wrapped up in dried eelgrass (*Zostera marina*) and then burned.

The soft-shell clam was consumed in great quantities by the seashore dwellers of this region, some mounds consisting largely if not entirely of this species, but the quahog was not found by Baird in the mounds of eastern Maine and adjoining New Brunswick. Loomis and Young (1912), however, found the quahog in shell heaps on the coast of Maine. The oyster likewise was not encountered on Passamaquoddy shores by archeologists, although again Baird and Loomis and Young described a single large mound at Damariscotta, Maine, consisting almost entirely of this species. Today this bivalve is rarely found on the coast of Maine. Alternating layers of shells and of animal bones in the refuse heaps is interpreted by Baird (1882) as the result of summer gathering at the seashore alternating with winter hunting of game.

From the St. John River the following fishes were taken: Salmon, gaspereau (fresh-water herring or alewife), shad, striped bass, sturgeon, eel, smelt, and white perch. Barratt (1851) gave a brief account of salmon fishing with spears of rock maple. Striped bass and sturgeon were speared and, beside being used for food, the end of the nose was cut off and used as a rubber ball for play. Some fish were smoked, especially the salmon, gaspereau, shad, sturgeon, and eel. Decayed wood was used for the smoking. Eels were speared and were also taken in eel pots or traps (kadewi·gałhi·gan) made of splints. In fresh-water ponds and lakes, togue, pickerel, chubs, suckers, and shiners were fished. Another one called the gizzardfish was mentioned by our informants. The identity of this is not clear, but it might possibly refer to the gizzard shad. In recent times trout have been introduced into the waters of New Brunswick. Food, oil, and fertilizer were the products obtained through fishing.

Snapping turtles and their eggs were gathered for food. The reptile lore of these Northeastern Indians has been treated in an earlier paper (Speck, 1923). An interesting superstition from the Malecite is pointed out in that paper to the effect that a snakeskin worn about the head will ward off enemies.

As far as can be determined, river mussels and crayfish were not eaten although the fresh-water clams were used for bait. Bailey (1887) found wampum (or shell beads) manufactured from fresh-water clams.

The muskrat was one of the most important animals in Malecite culture. Both flesh and brains were used for food, the intestines were used in medicine, especially for diarrhea, and the hide was used for many purposes. Our informants described the cooking of muskrat by placing the whole carcass on coals. Jack (1895) relates that "the Malecite were known by other tribes of the Abenaki as 'the Mouskouasoaks' or water rats either because, like these animals, they lived on the banks of the river or because they highly esteem the muskrat as food which they do at the present time, preferring its flesh beyond that of any other." The beaver and otter were other aquatic mammals of considerable value to these people. Beaver tail was considered a special delicacy, and the incisor teeth were made into knives. Ducks and geese and their eggs were taken in season for food. Ducks were cooked in a mud ball placed on coals. After the mud had dried and cracked, it was peeled off removing feathers and skin from the carcass. Our informants described the testing of duck eggs before using—fresh eggs sink in salt water, whereas those which are in process of development will float to the surface. Sandpipers, plovers, snipe, and woodcock were also eaten. The upland game pursued by the Malecite was essentially the same as that sought by the Micmac. The woodland caribou, moose, and white-tailed deer were the important ungulates that served as food and provided skins for clothing and shelter. Moose hide was used in making canoes and mocassins as well as clothing; the intestines, in cording snowshoes. The intestines were also cleaned, dried, and stored for winter food. Moose hair was used for embroidery on pouches and containers made from animal skins. The hides of all these large animals were used in making bags and containers. Sometimes the whole skin of one animal was adapted for that purpose. The black bear likewise was utilized for many purposes—flesh for food, hides and fur for clothing and shelter, intestines for bow strings, teeth and claws for beads and decoration, and bones for scrapers. Children ate the fat as a tidbit. Bears were captured chiefly by the deadfall trap (aᶜhazi·hi'·gan). Flesh of muskrat, beaver, caribou, moose, and deer was dried and smoked.

The snowshoe hare was trapped in the following manner. A pile of birch boughs was built to attract the animal. A fence was then constructed around this pile containing several openings through which the hares could pass to reach the source of food. Snare traps (abe'k^{c}towa'gɑn) were set in these openings to capture them as they passed through. Red and gray squirrels and woodchucks were also hunted. Tobacco pouches were made from the skins of woodchucks. Porcupine meat and quills were utilized as much by the Malecite as by the Micmac. Mr. Polchis said it was the easiest of the animals to kill. McIntosh (1909) found that designs on aboriginal pottery frequently resembled the porcupine quill ornamentation found on birch-bark vessels as well as that of spruce-root stitching. He believed these designs were suggested by the quill work on the bark vessels which long antedated the manufacture of pottery ware in this region. The raccoon, skunk, weasel, mink, pine marten, fisher, wolverine, and lynx were the common animals hunted for fur. The raccoon was also used for food, and the os baculum (penis bone) of this animal and the mink served as an ear pick for the Indians. Chamberlain (1884) listed both the Canada lynx and the bay lynx for New Brunswick and noted that pine marten was common at the time of his writing, but the fisher was rare. The woodland caribou was still common at that date, whereas the Virginia deer was uncommon but increasing in number. He also noted that the red squirrel was very abundant but the gray squirrel (mi'·ko) was rare. The Canada ruffed grouse and spruce grouse, called fool hen by the Malecite, were among the most important forest birds. Fans were made from the tail feathers of these birds. The ring-necked pheasant has been introduced in recent times and the passenger pigeon, once so abundant, has become extinct. There is no indication that the American wild turkey ever extended this far in its range. Mr. Polchis called to our attention that hunters considered it bad luck to shoot an owl. Birdlore of the Northern Indians was the subject of an earlier paper by the senior author (Speck, 1921).

The hunting, fishing, and trapping devices of the Malecite were essentially the same as those employed by the Micmac. These included the harpoon (si·gɑwan), dip net (azɑhi'·gɑn), hook (pki'·^{c}k·ɑn), spear (sapti·hi'·gɑn), leister (ni'·gak), torch (pu$^{\smile}$'segwo$^{\smile}$n), bow and arrow (ta'b nazaba^{c}k^{w}), traps (kɑlhi'·gɑnɑl), and others mentioned above. Here again the family hunting ground system regulated the taking of game and served to keep the Indian population in balance with the game populations (Cooper, 1939; Speck and Eiseley, 1939; Speck and Hadlock, 1946; Hallowell 1949).

Mr. Polchis mentioned eating black ants in the springtime for medicinal purposes. Only rarely did our informants mention the medical uses of animals and plants, and they were very reluctant to discuss the purposes for which certain native medicines were used. Mr. Polchis explained that it was tabu to discuss with members of the same sex medicinal properties of animals and plants for fear of losing the power of these medicants. Presumably one could discuss such matters with the opposite sex without fear of losing their value.

The coniferous trees, as abundant in Malecite territory as in that occupied by the Micmac, were commonly utilized. Roots for thread were obtained from the black and white spruce and balsam fir. Needles and branches of these same evergreens were used for pillows and bedding, while the pitch was used for waterproofing seams in the canoes, and in medicine. Bark of the white spruce was used for canoes and roofing the huts. Arrow shafts were made from tamarack. The bark of hemlock (k^{c}sius$^{?}$k), tamarack, and yew served for medicine, and from the bark of hemlock a dye and tanning material was obtained. From white cedar (arbor vitae), wood for canoe slats and arrows was sought, and the bark was used in tanning hides. Of the deciduous trees, white or canoe birch was of greatest importance because of the uses of its bark for canoes, boxes, and containers of all kinds. Yellow birch was employed in the manufacture of sled and toboggan runners. The wood, stripped of the bark, was heated and used like the hot-water bottle of the white man. Brooms were also made from birch. Basket splints were made from brown ash, red maple, and white cedar, and the fiber from basswood was made into belts and ropes as well as for sewing birch bark. White ash was used for making boat frames and snowshoes. Elm (dje's·agɑnk^{w}) bark was sometimes substituted for birch bark in the construction of bark canoes. Ironwoods (the hornbeams) were used for making bows and handles for utensils. Torch handles, paddles, and oars were made from the wood of sugar maple. Medicines were prepared from slippery elm, wild cherry, black cherry, sumac, alder, and the oaks. Willow bark was mixed with tobacco, and some-

times acorns mixed with dried willow bark was substituted for tobacco. Pipes were made from the wood of wild cherry, among other things. Even food was derived from the hardwoods. Maple syrup and sugar were tapped from the sugar-maple tree. Fruits were eaten from the wild plum, black cherry, choke cherry, and the sand cherry. Gorham (1943) reports the finding of charred plum pits found among the ashes of prehistoric campfires on old village sites, and clumps of plum trees (*Prunus nigra*) have been found still living on or near these village sites, relics of the new stone age. Since this plum is found in New Brunswick only in the vicinity of present or past habitations of man, Gorham has suggested that it might be a relict of aboriginal agriculture. Nuts were gathered from the hazelnut shrub and from butternut, beech, and oak trees. The acorns of the red, black, and white oak (wa'ᵉtci·lamas) were baked. All the woods, especially the hardwoods, were used as fuel. Two species of trees have been introduced from the Old World that are of special interest. The balm of Gilead (ewebi·bak) is a source of medicine, especially salves, and of trap scents. The Lombardy poplar, however, was described as a cursed tree which brings bad luck. Land having the Lombardy poplar was said to be cursed, and the nearly verticle position of the branches is interpreted as a symbol asking for its forgiveness.

All the fruits and berries listed in the paper on the Micmac group were gathered by the Malecite, and, in addition, dewberry, bilberry (a'nkwudawaba'wi·mus), and mooseberry, the latter not recognized by the authors, were named by our informants. Adney (1944) has made a special study of the native fruits and berries known to the Malecite. In spite of the wide variety of wild fruits eaten, the Indians were cautious about eating strange fruits and berries without consulting older people to determine whether they were suitable for food. Some fruits and berries were dried for winter use. The wild onion, the wild potato (taᵉki·dɑmuk), and the roots of the bracken fern were harvested for food, and shoots of pokeberry and fiddlehead ferns were gathered for food. A number of introduced weeds have been added to the diet since the advent of colonization. Among these are the dandelion, wild mustard, pig weed, and lambs quarters. Wildrice, widely used among the eastern Indians, was harvested. Teas were prepared from wintergreen, Labrador tea, and the barks of many trees, but especially that of the yellow birch. In preparing teas a green stick was placed across the boiling vessel to prevent it from boiling over. Sweet flag, skunk-cabbage, and goldthread were used for medicines and sweet grass has been introduced for basket-making. Sphagnum mosses and cattail down served for absorbents and filling for mattresses.

American Indians lived close to nature. They had an intimate knowledge of animals and plants —where they lived, how they behaved, what use could be made of them, when and how they could be obtained. They had great respect for natural resources. Their stories and legends revolved about native animals particularly. Their whole lives were intricately woven into a pattern of plant-animal-man relationships.

TABLE 1.—ANIMALS AND PLANTS UTILIZED BY THE INLAND MALECITE INDIANS, CHIEFLY FOR FOOD OR FOOD PROCUREMENT

Scientific Classification	English Name	Scientific Classification	English Name
INSECTA:		PISCES (Continued):	
Formicidae	Black ants	Cyprinidae	Shiners; minnows
PISCES:		*Esox lucius*	Pike; pickerel
Acipenser oxyrhynchus	Sturgeon	*Perca flavescens*	Yellow perch
Anguilla bostoniensis	Eel	REPTILIA:	
Dorosoma cepedianum ?	Gizzard shad; gizzardfish	*Chelydra serpentina*	Snapping turtle
Pomolobus pseudoharengus	Alewife; fresh-water herring; gaspereau	AVES:	
Alosa sapidissima	Shad	*Branta canadensis*	Canada goose
Salmo salar	Atlantic salmon	*Chen hyperborea*	Snow goose
Cristivomer namaycush	Togue; namaycush; lake trout	Anatinae; Nyrocinae	Surface-feeding and diving ducks
Osmerus mordax	Smelt	*Canachites canadensis*	Spruce grouse
Roccus sazatilis	Striped bass	*Bonasa umbellus*	Ruffed grouse
Morone americana	White perch; sea perch	*Phasianus colchicus*	Ringed-neck pheasant
Catostomidae	Suckers	Charadrioidea	Shorebirds
Leucosomus corporalis	Chub	*Philohela minor*	Woodcock

TABLE 1.—(*Continued*)

Scientific Classification	English Name	Scientific Classification	English Name
AVES (Continued):		ANGIOSPERMAE (Continued):	
Capella delicata	Wilson's snipe	*Allium* spp.	Wild onion
Actitis macularia	Spotted sandpiper	*Salix* spp.	Willows
Larinae	Gulls	*Populus gileadensis*	Balm of Gilead
Ectopistes migratorius	Passenger pigeon	*Juglans cinerea*	Butternut
MAMMALIA:		*Corylus* sp.	Hazelnut
Euarctos americanus	Black bear	*Ostrya virginiana*	Hop-hornbeam; ironwood
Procyon lotor	Raccoon	*Carpinus caroliniana*	Hornbeam; ironwood
Martes americana	Marten	*Betula* spp.	Birches
Martes pennanti	Fisher	*Betula papyrifera*	Canoe birch; paper birch
Mustela cicognani	Weasel	*Alnus* spp.	Alder
Mustela vison	Mink	*Fagus grandifolia*	Beech
Gulo luscus	Wolverine	*Quercus* spp.	Oaks
Lutra canadensis	Otter	*Ulmus americana*	American elm
Mephitis mephitis	Skunk	*Chenopodium* sp.	Pigweed
Lynx canadensis	Lynx	*Phytolacca americana*	Poke; pigeonberry
Marmota monax	Woodchuck	*Coptis groenlandica*	Goldthread
Sciurus hudsonicus	Red squirrel	*Brassica* spp.	Mustard
Sciurus carolinensis	Gray squirrel	*Ribes* spp.	Currants; gooseberries
Castor canadensis	Beaver	*Crataegus* spp.	Hawthorn
Ondatra zibethica	Muskrat	*Fragaria virginiana*	Strawberry
Erethizon dorsatum	Porcupine	*Rubus* spp.	Raspberries; blackberries; dewberries
Lepus americanus	Showshoe rabbit; varying hare		
Odocoileus virginianus	White-tailed deer; Virginia deer	*Prunus* spp.	Wild cherries; black cherries; beach plum; sand plum
Alces americana	Moose		
Rangifer caribou	Woodland caribou	*Apios americana*	Wild bean; groundnut
BRYOPHYTA:		*Acer pennsylvanicum*	Moosewood; striped maple
Sphagnum spp.	Sphagnum moss	*Acer saccharum*	Sugar maple; rock maple
PTERIDOPHYTA:		*Acer rubrum*	Red maple
Filicinae	Ferns	*Vitis vulpina*	Wild grape; river-bank grape
GYMNOSPERMAE:		*Tilia americana*	Basswood
Taxus canadensis	Yew; ground hemlock	*Cornus canadensis*	Bunchberry
Pinus strobus	White pine	*Pyrola* sp.	Wintergreen
Larix laricina	Tamarack	*Ledum groenlandicum*	Labrador tea
Picea glauca	White spruce	*Gaultheria procumbens*	Teaberry; checkerberry
Picea mariana	Black spruce	*Vaccinium* spp.	Blueberries; cranberries
Abies balsamea	Balsam fir	*Fraxinus americana*	White ash
Tsuga canadensis	Hemlock	*Fraxinus nigra*	Black ash; brown ash
Thuja occidentalis	White cedar; arbor vitae	*Viburnum opulus*	Highbush cranberry
Juniperus spp.	Red cedar; juniper	*Viburnum lentago*	Sheepberry
ANGIOSPERMAE:		*Mitchella repens*	Partridgeberry
Zostera marina	Eelgrass	*Sambucus canadensis, S. pubens*	Elderberries
Zizania aquatica	Wildrice		
Hierochloë odorata	Sweetgrass	*Helianthus tuberosus*	Artichoke; wild potato
Symplocarpus foetidus	Skunk-cabbage	*Taraxacum officinale*	Dandelion
Acorus calamus	Muskrat-root; sweet flag		

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PALEONTOLOGY.—*Stratigraphic range of the ostracode genus* Phanassymetria *Roth.*[1] I. G. SOHN and JEAN M. BERDAN, U. S. Geological Survey. (Communicated by John B. Reeside.)

The genus *Phanassymetria* was established by Roth (1929, p. 358) for two species of ostracodes from the Haragan marl (Lower Devonian) of Oklahoma. In 1936 van Veen (1936, p. 177) discussed this genus and assigned to it two species from the Upper Cretaceous of Holland. As has been noted by Kellett (1943, pp. 626–627), this created a surprisingly long range for the genus, and because other species from intermediate periods have not been recorded, it appeared desirable to review the generic characters of both the Lower Devonian and the Cretaceous species. We have been fortunate in having van Veen's paratype material for study, as well as Roth's types from the Haragan marl, and have observed morphological differences between the Lower Devonian and the Cretaceous species. In this paper the genus *Phanassymetria* is limited to those forms occurring in rocks of Silurian and Devonian age, and a new genus is established for the Cretaceous species.

We are grateful to Drs. G. A. Cooper and David Nicol, of the U. S. National Museum, for arranging the exchange of van Veen's paratype material through Dr. J. H. van Voorthuysen, Geologische Dienst, Haarlem, Holland, and for making available Roth's types. Dr. R. A. M. Schmidt, of the U. S. Geological Survey, prepared the radiographs used in illustrating this paper, and her cooperation is gratefully acknowledged. Mrs. Elinor Stromberg prepared the illustrations. We also wish to thank Dr. Kurt Rosenwald and Mrs. Severine Britt for assistance in translating the quoted portions of van Veen's discussion of *Phanassymetria* from the German.

MORPHOLOGY OF OSTRACODE SHELLS

The most recent discussion of the shell structure of ostracodes is that by Sylvester-

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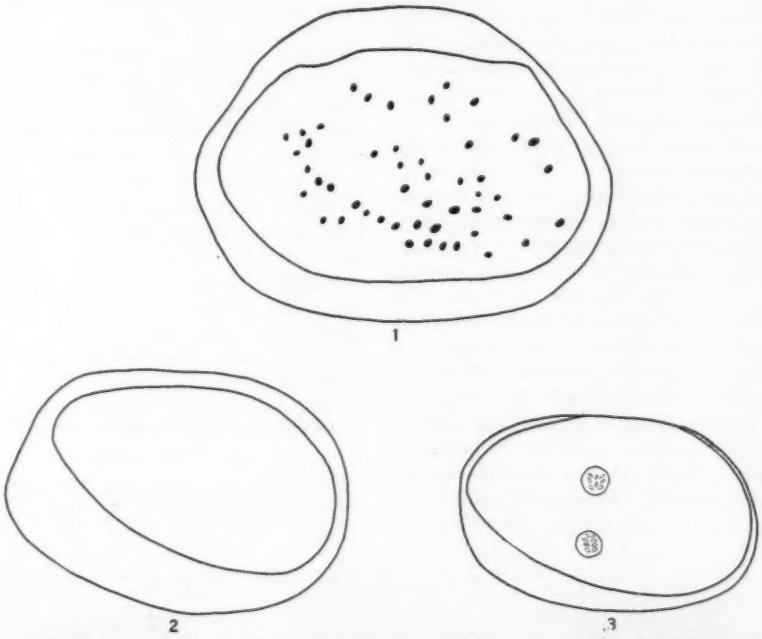
Bradley (1941, pp. 1–33). The valves of living ostracodes are pierced at right angles to the surface by pores known as "normal pore canals," from which hairs protrude. In general, these pores are not recognizable on Paleozoic ostracodes, although they can be observed on many post-Paleozoic forms.

Swartz (1936, p. 581) described the early Paleozoic genus *Tubulibairdia* as characterized by "coarse tubular pores which open on the internal surface of the valves, but do not reach the exterior." The same type of pore occurs in the Paleozoic species of *Phanassymetria* (Fig. 1) and in other Paleozoic genera. If the tubules are normal pore canals they should be present in all the genera of a given faunule that contains specimens in which the tubules can be seen. We have examined material from several localities of Silurian and Devonian age and have observed that the tubules are restricted to a group of genera related to *Phanassymetria*. The tubules can be seen on the inside surface of well-preserved valves. In some cases they appear as perforations through the shell wall of abraded specimens. They may also be seen by transmitted light on wetted specimens of both complete carapaces and dissociated valves. Under some conditions of preservation it is necessary to make thin sections to determine the presence of the tubules. They show very plainly on radiographs of the valves. Examination of van Veen's paratype material from the Cretaceous of Holland fails to show any indication of these tubules, either with transmitted light or on the radiographs. The following translation of the discussion of the genus *Phanassymetria* by van Veen shows that she was not aware of the presence of the tubules in the early Paleozoic species:

> This genus was established by Roth for two Lower Devonian ostracodes from America whose valves, as the name indicates, are distinctly asymmetrical. Their asymmetry consists in one valve being much larger than the other and overlapping it on all the margins.
>
> Roth arbitrarily established the wider end as anterior, thus making the right valve larger. This orientation should very likely be reversed, making the left valve the larger, as is the usual case with ostracodes. This orientation is indicated also by the fact that in *P. quadrupla* the posterior and not the anterior end varies considerably in width. Roth states that in both of his species the hinge of the valve which we consider as the left has a furrow and the right valve is flanged ["scharf"]. On the other hand, we believe that in our two species the opposite is the case, as is usual with other ostracodes.
>
> Roth does not give generic characteristics, but describes in detail his two species. Bassler and Kellett (1934, p. 37) describe the genus in their Bibliographic Index of Paleozoic Ostracodes. They, however, base their description mainly on the genotype. They place this genus in the family Thlipsuridae. The following may be mentioned as the chief characteristics: The carapace is thick and strongly asymmetrical, since the left valve is much larger than the right one, and overlaps it on all the margins. The surface of the valves is smooth or punctate. Hinge margin straight, and hinge teeth absent.
>
> Roth as well as we [van Veen] found two types of forms of this genus. We, therefore, originally concluded that his as well as our specimens represented a species exhibiting strong sexual dimorphism. The illustrations given by Roth do not contradict this assumption; *P. triserrata* would be the female and *P. quadrupla* the male. In order to investigate this problem a sample of Haragan marl from White Mound, Oklahoma, was obtained from Prof. R. W. Harris through the courtesy of Dr. Merle Israelsky to both of whom we express our sincere thanks. The sample contained a great number of complete carapaces and dissociated valves of the two species of *Phanassymetria* differentiated by Roth. We concluded that our assumption is most likely not correct because we believe that we are able to differentiate longer and shorter carapaces in both species ["Gattungen"] with a greater number of shorter ones.
>
> Fossils of this genus were found only in the Lower Devonian of North America and in the Cretaceous of South Limburg, the former being much larger.
>
> It may be mentioned that Bonnema (1932, p. 288; 1933, p. 25) was referring to this genus when he wrote "pot-with-lid."

As may be seen from the above discussion in addition to lacking tubules that are characteristic of *Phanassymetria*, the Cretaceous species differ in being smaller. It might be

considered as a possibility that the small size coupled with the absence of pores in the Cretaceous forms represents an atavistic reversion or a juvenile stage of the *Phanassymetria* stock. That this is not the case is shown by the presence of pores in a juvenile growth stage of *Phanassymetria*, which is about half the size of the adults, from the type locality at White Mound, Oklahoma. This juvenile specimen has a length of 0.5 mm as compared with a length of 0.4 mm for the Cretaceous specimens. It therefore appears that the resemblance between the lower Paleozoic and the Cretaceous species is due to homeomorphy rather than any genetic relationship. Even this resemblance is more apparent than real, however, as the "groove" on *P. foveata* van Veen, which is supposed to resemble that on *P. triserrata* Roth, is actually a shallow subtriangular depression oblique to the hinge line (Fig. 5) rather than a groove open posteriorly and parallel to the hinge line as in the Paleozoic species. The thickness of the shell wall of the Paleozoic specimens appears to be proportionately greater than that of the Cretaceous specimens. In *P. afoveata* van Veen, no pit or groove is present, and the resemblance to the lower Paleozoic forms is in the general outline and in the alleged thickness of the shell walls. Considering these factors, and considering that no species assignable to *Phanassymetria* have been found in either the upper Paleozoic or the lower Mesozoic, it seems desirable to remove the Cretaceous species from the genus *Phanassymetria*.



FIGS. 1–3.—1, *Phanassymetria* sp.: Left valve from the inside, camera-lucida drawing, approx. × 66, showing the tubules. Marl beds of Haragan shale west of Clarita, Coal County, Okla., donated by Robert H. Stewart, U. S. Geological Survey, who obtained the sample from Prof. William Shideler, Miami University, Oxford, Ohio, U.S.N.M. no. 116454. 2, *Pseudophanasymmetria foveata* (van Veen): Complete carapace, lateral view of right side, camera-lucida drawing from radiograph, approx. × 113; tubules not present. Van Veen's paratype material, Maestrichtian from South Limburg, Holland, U.S.N.M. no. 108231. 3, *Pseudophanasymmetria? afoveata* (van Veen): Complete carapace, lateral view of right side, camera-lucida drawing from radiograph, approx. × 113; tubules not present. The specimen was tilted when the radiograph was made so that the muscle scar patterns, presumed to be located opposite each other, are projected on the plane of the film as two units. The upper pattern is interpreted to belong to the right valve, and the lower to the left valve. Van Veen's paratype material, Maestrichtian from South Limburg, Holland, U.S.N.M. no. 108232.

Family BAIRDIIDAE? Sars, 1887

Pseudophanasymmetria Sohn and Berdan, n. gen.

Phanassymetria (part) van Veen, Natuurhist. Maandblad, Jaarg. 25, no. 11–12: 177. 1936.

Genotype *P. foveata* (van Veen), ibid.: 177–178, pl. 10, figs. 16–22.

Diagnosis.—Markedly asymmetrical ostracodes with shells not penetrated by conspicuous large pores. Larger valve overlaps smaller on all margins. Hinge straight, simple, reported by van Veen to consist of a bar and groove. Both dorsal and lateral outlines subovate. Shell surface either smooth or punctate, and with a shallow depression on the posterodorsal part of the shell. Inner lamella not observed, probably absent.

Discussion.—The reasons for separating this genus from *Phanassymetria* have been cited above. Van Veen placed two Cretaceous species, *P. foveata* and *P. afoveata*, in *Phanassymetria*. Of these two, *P. foveata* has been selected as the type of the new genus. Van Veen (1936, p. 178) has stated that *P. foveata* and *P. afoveata* resemble each other in having the left valve much larger than the right and overlapping it on all margins, and also in having a small spine on the posterior margin of each valve. These spines are very small, and, according to van Veen, many of them are abraded. As such spines in many ostracode genera are not even of specific importance, the principal indication of relationship between the two species is the similarity in overlap. The species differ in the presence of surface sculpture in *P. foveata* as opposed to *P. afoveata*, and in a well-defined muscle scar in *P. afoveata*, which has not been observed in *P. foveata*. It is, therefore, possible that examination of additional material will show that the two species do not belong to the same genus. However, the material available to us, which consists of a complete carapace and one larger valve of each species, does not justify the proposal of an additional genus. The species *afoveata* is provisionally referred to *Pseudophanasymmetria*. The following species appear similar to *Pseudophanasymmetria? afoveata:*

Bairdia subglobosa Bosquet, 1852, Memoires Couronnes et Memoires des Savants Étrangers publiés par l'Académie Royale des Sciences, des Lettres et des Beaux-arts de Belgique **24**: 25, pl. 1, figs. 7a–d. Cretaceous to Miocene.—Bosquet, 1854, Mon. Crust. foss. Crétacé de Limburg: 65–66 (55–56), pl. 8, figs. 3a–d.

Bairdia subglobosa Méhes, 1911, Resultate der Wissenschaftlichen Erforschung des Balatonsees **3**: pt. 6: 21, pl. 2, figs. 11–13, Triassic.

Bairdia (?) problematica Méhes, 1911 (= *Hungarella problematica* (Mehes)), Resultate der Wissenschaftlichen Erforschung des Balatonsees **3**: pt. 6: 21, pl. 2, figs. 14–18, Triassic.

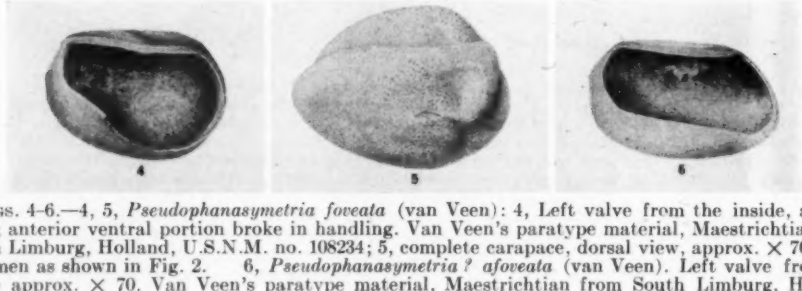
Bairdia (?) problematica var. *reniformis* Méhes, 1911 (= *Hungarella problematica* var. *reniformis* (Méhes)), Resultate der Wissenschaftlichen Erforschung des Balatonsees **3**: pt. 6: 22–23, pl. 2, figs. 19–23, Triassic.

Further study may disclose that the listed species and *Pseudophanasymmetria? afoveata* belong to the same group, and in one or more genera. Bosquet's statement (1854, footnote, explanation to pl. 8) that the specimens described as *B. subglobosa* are young individuals of *B. subdeltoides* is probably not correct, because we have observed growth stages of species of Paleozoic *Bairdia* and of post-Paleozoic *Bairdoppilata* in which the younger stages have the same lateral and dorsal outlines as the adults. The Triassic species referred by Méhes to *Bairdia subglobosa* probably does not belong to it, and may require a new name.

Pseudophanasymmetria foveata (van Veen), 1936

Figs. 2, 4, 5

Phanassymetria foveata van Veen, Natuurhist. Maandblad, Jaarg. 25, no. 11–12: 177–178, pl. 10, figs. 16–22. 1936.



FIGS. 4–6.—4, 5, *Pseudophanasymetria foveata* (van Veen): 4, Left valve from the inside, approx. × 70; anterior ventral portion broke in handling. Van Veen's paratype material, Maestrichtian from South Limburg, Holland, U.S.N.M. no. 108234; 5, complete carapace, dorsal view, approx. × 70; same specimen as shown in Fig. 2. 6, *Pseudophanasymetria ? afoveata* (van Veen). Left valve from the inside approx. × 70. Van Veen's paratype material, Maestrichtian from South Limburg, Holland, U.S.N.M. no. 108233.

A translation of the original description follows:

This species is represented by 4 carapaces and 21 left valves. Right valves are absent, presumably because of their smaller size.

Carapace thick. Egg-shaped in lateral view, greatest height anterior to midlength. Anterior margin broadly rounded. Posterior margin somewhat truncated. Dorsal margin straight, ventral margin slightly convex. These two margins converge strongly backward, dorsal and ventral outline also egg-shaped, greatest width is behind midlength. Lengthwise very irregularly triangular, with greatest width below midhieght so that the carapace is flattened out below.

It is very characteristic that the left valve has a sulcus [Grube] located on the outside in the back below the dorsal margin. The margins of the sulcus are elevated, except along dorsal margin. Strange to say, a similar sulcus is found in *P. triserrata* Roth, but there the elevation is lacking. The surface of the valves is finely punctate, with small dots that are arranged in rows. It is further characteristic that each valve has on its posterior a little spine, which, however, is often abraded. In *P. triserrata* such a spine is present on the dorsal surface of each valve.

This ostracode is present in Staring's third Bryozoa bed in the Jeker Valley, and in the first Bryozoa layer of Maestrichtian "d" at Bemelen.

Measurements (in millimeters):

	Greatest length	*Greatest height*	*Convexity*
Complete carapace	0.44	0.32	0.31
Left valve	0.41	0.29	—

The extremely small size of the specimens suggests that they possibly represent young growth stages. The original of van Veen's figs. 16–20, pl. 10, is here designated as the lectotype.

Pseudophanasymmetria? afoveata (van Veen), 1936

Figs. 3, 6

Phanassymetria afoveata van Veen, Natuurhist. Maandblad, Jaarg. 25, no. 11–12: 178, pl. 10, figs. 23–30. 1936.

A translation of the original description follows:

This ostracode, too, belongs to the less common species, being represented by four complete carapaces, six left valves, and one right valve. The relationship of this ostracode with the previous one results from the fact that the left valve is much larger than the right and overlaps it all around, and that each valve bears a little spine on the posterior margin. It differs from the former by being smaller, less thick, more slender, and more cylindrical in shape. Moreover, the surface is not punctate. Furthermore, the groove on the posterior part is absent.

This species is found in Staring's third Bryozoa bed in the Jeker Valley and in the first Bryozoa bed at Bemelen.

Measurements (in millimeters):

	Greatest length	*Greatest height*	*Convexity*
Complete carapace	0.40	0.26	0.26
Left valve	0.41	0.26	—

The extremely small size of the specimens suggests that they possibly represent young growth stages. A complete carapace and two larger valves were available to us for study, but unfortunately one of the larger valves was destroyed during the process of obtaining radiographs, and a portion of the larger valve of the carapace was broken after a satisfactory radiograph was obtained. The radiograph of the carapace shows muscle scar patterns on both valves (Fig. 3). The pattern is circular and consists of eight discernible scars that differ in arrangement in the opposing valves. It is not known whether this asymmetry in arrangement of the individual muscle fibers is typical in ostracodes. The arrangement of the muscle scar pattern is similar to that of *Hungarella* Méhes (1911, p. 22) as figured by him for *Bairdia(?) problematica* Méhes, 1911, on pl. 2, fig. 16. The small scars that surround the central group in *Hungarella* are not discernible in *P. afoveata*. The original of van Veen's figs. 23–27, pl. 10, is hereby designated as the lectotype.

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PALEONTOLOGY.—*The arms of* Polusocrinus. HARRELL L. STRIMPLE, Bartlesville, Okla. (Communicated by Alfred R. Loeblich, Jr.)

Several months ago, Gregory Elias, of Gulf Oil Corporation, found a specimen of *Polusocrinus* Strimple (1951) with well-preserved arms attached. The specimen was obtained by the author through exchange and provides vital information for the study of ampelocrinids. The specimen was collected in the small excavation about half a mile due west of the school at Ochelata, Okla., in the Wann formation. This zone is also found at the hill, locally termed "The Mound," just west of the city limits of Bartlesville, Okla., where several specimens of the species have been collected by the author. Description is given below as *P. ochelataensis*, n. sp.

Genus **Polusocrinus** Strimple, 1951

There have been some questions raised as to the practicability of the genus *Polusocrinus*. One characteristic, which was not brought out by the author, is the lack of depth of the arm articulating facets found in the genus. In *Aesiocrinus magnificus* Miller and Gurely (1890), the genotype species, and in other typical representatives of that genus, the arm articulating facets attain a depth somewhat greater than the normal thickness of the RR. Typical species also have a shallow basal concavity. *Oklahomacrinus* Moore (1939) has comparable arm articulating facets, but the genus is characterized by extreme basal invagination, quite foreign to the convex base of *Polusocrinus*. The form described as *Moundocrinus osagensis* Strimple (1939) has the same type of arm articulating facets as *Polusocrinus* but the anal plate of that species is only faceted for the reception of a single tube plate, and the IBB circlet is smaller and downflared in attitude. In both *Polusocrinus* and *Aesiocrinus* the anal plate is followed by two tube plates.

With the knowledge afforded by the crown of *P. ochelataensis*, we are able to anticipate from fourteen to sixteen arms in *Polusocrinus*. Most Pennsylvanian genera assigned to the Ampelocrinidae have only ten arms, and one, *Allosocrinus* Strimple (1949), has only five. *Exocrinus* Strimple (1949) has numerous arms, but the author contemplates removal of this genus from the ampelocrinids in the near future.

Polusocrinus ochelataensis, n. sp.

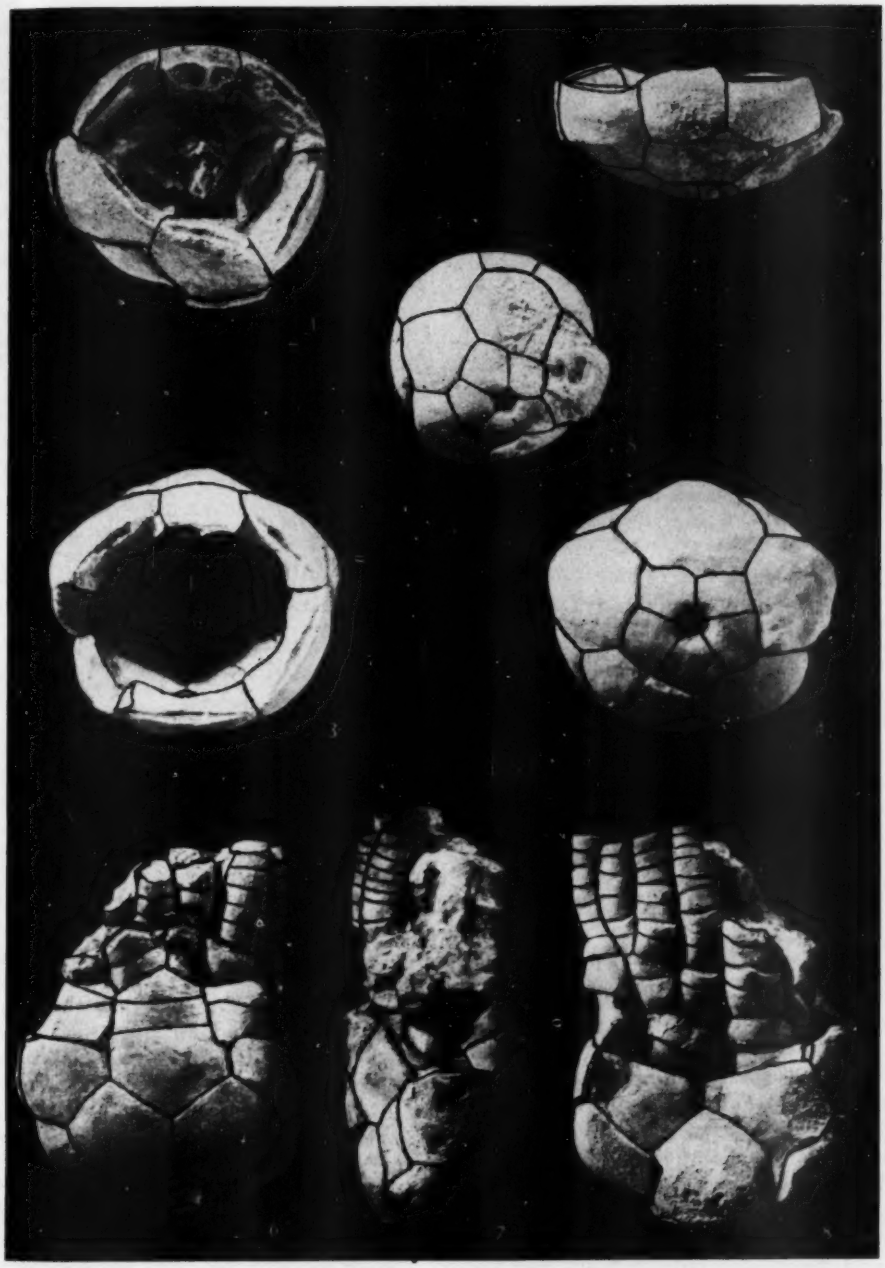
Figs. 1–8

Dorsal cup is full, semiglobular shaped. Five IBB form a large, pentagonal disk, which is shallowly concave about the columnar attachment but is mildly convex in its entirety. Five large BB are hexagonal except for the post. B, and are equally wide as long. Five RR are slightly wider than long and are pentagonal. Articulating facets slope inward and attain a length only 0.7 mm greater than the normal thickness of the RR. One large anal plate is present, resting evenly on the upper truncated extremity of the post. B. It extends only slightly above the upper extremity of the cup and attains its maximum width at the upper level of the cup. There is provision for the reception of two tube plates of equal size.

The entire crown is devoid of ornamentation and the sutures of the cup are not impressed. The column is pentagonal and the lumen is pentalobate. The tegmen has not been observed.

First bifurcation of the arms occurs on the low axillary second primibrachials in all rays. Subsequent branching is known in the left ray of all rami except the r. post. where preservation is not clear enough to be certain. The second secundibrachials are axillary in all left rays with the exception of the anterior where the first SBr is an unusually large axillary plate. The arms are uniserial and are well rounded, appearing not to have reposed in close contact. No branching has been observed in the right rays.

Measurements in mm.—As follows:



FIGS. 1-8.—*Polusocrinus ochelataensis*, n. sp.: 1, 5, Paratype from summit, × 2, and from base, × 1.5; 2-4, large paratype from posterior, summit, and base, × 1.4; 6-8, holotype from right anterior, posterior, and left anterior, × 1.5.

	Holotype	Large paratype
Width of dorsal cup (max.)	26.5*	29.2*
Height of dorsal cup (max.)	14.2*	14.3*
Length of ant. R	8.7	10.0
Width of ant. R	13.2	15.7
Length of suture between RR	3.9	4.0
Length of arm articulating facet at suture	3.7	—
Normal thickness of RR	3.0	—
Length of r. ant. B	11.9	14.6
Width of r. ant. B	11.9	14.7
Length of suture between BB	6.3	5.6
Diameter of IBB circlet	12.2	14.2
Diameter of columnar scar	4.1†	3.5
Length of anal plate (max.)	7.7	7.5
Width of anal plate (max.)	7.9	9.0

* Distorted.
† Proximal columnals.

Remarks.—*P. ochelataensis* has characteristics closely comparable to other described species referred to the genus. However, it has a more convex base and is the largest known species. The RR plates are wider and lower than those of *P. avanti* Strimple (1951), and the anal plate does not extend so far above the summit of the cup. The BB plates of *P. rosa* Strimple (1951) are proportionately wider than those of the present species.

Occurrence and horizon.—The holotype is from a small excavation approximately one-half mile due west of Ochelata, and the paratypes are from the hill just west of the city limits of Bartlesville, Oklahoma; Wann formation, Ochelata group, Missouri series, Pennsylvanian.

Types.—To be deposited in the U. S. National Museum.

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ENTOMOLOGY.—*Phylogenetic studies of* Franklinothrips (*Thysanoptera: Aeolothripidae*).[1] LEWIS J. STANNARD, JR. Illinois Natural History Survey, Urbana, Ill. (Communicated by Herbert Friedmann.)

The unusual aeolothripid genus *Franklinothrips* has been of particular interest to most thysanopterists. Whenever examples came to hand they were deemed worthy of special comment even when taxonomic considerations were not involved. Since at first it was not realized that dimorphic variation occurred in the antennal segments and heads of the sexes and since all but two of the seemingly new species were described from unique specimens, it is not too surprising that 11 species, 3 genera, and 1 family have been described or proposed for this small genus of six species.

Perhaps the most impressive feature of the *Franklinothrips* is the extremely elongated and slender third and fourth antennal segments, which bear elaborate sensoria (Figs. 1–3). For aeolothripids, their wings are narrow and the veins are exceptionally faint, so faint that some students formerly believed no cross veins were present. At least when dead, the head is often partially withdrawn into the prothorax giving this part of the body a compact appearance. In nature they resemble ants somewhat.

In spite of the paucity of collections of these thrips, enough samples have been taken to indicate that they inhabit the warmer regions of the world and are confined to areas between the northern and southern latitudes of 35°. They are largely, if not entirely, predaceous, feeding on mites and insects including other thrips. The larvae spin flimsy pupal cocoons on the underside of leaves; there is but a single pupal stage in contrast to two or three pupal forms in all other thrips. Reijne (1920) published limited observations on their activities before and during the pupal stage, but details of the rest of their life history remain unknown. Occasionally males are attracted to lights but females have never been taken from this source.

Franklinothrips should not be confused with *Frankliniella*, another kind of thrips belonging to the family Thripidae.

Although only one type was available to me for study, borrowed identified specimens and freshly collected specimens of most of the other species were considered satisfactory reference material. Over 100 individuals of this genus were studied.

[1] This paper is a joint contribution of the Section of Faunistic Surveys and Insect Identification, Illinois Natural History Survey, and the Department of Entomology, University of Illinois.

I am sincerely grateful to Prof. Dr. Hermann Priesner, of Cairo, for the loan of male and female specimens of *F. megalops*; to C. F. W. Muesebeck and the late J. C. Crawford for permitting me to examine collections of *F. tenuicornis* and *F. vespiformis* at the United States National Museum (USNM); to George Mack, of the Queensland Museum, for the loan of the holotype of *F. variegatus*; and to Dr. W. E. China, of the British Museum, for the information he has given me on the type specimen of *F. aureus*. Drs. S. F. Bailey, H. K. Gloyd, B. W. Benson, and E. Williams and E. C. Becker have aided me by their suggestions or by the presentation of specimens which have been placed in the collections of the Illinois Natural History Survey (INHS).

Genus **Franklinothrips** Back

Franklinothrips Back, Ent. News **23**: 75–77. Mailed Jan. 31, 1912. [Monotypic; genotype by original designation, *Aeolothrips vespiformis* D. L. Crawford.]

Mitothrips Trybom, Ent. Tidskr. Arg. H. 3–4: 146–147. 1912. [Monotypic; genotype, *Mitothrips megalops* Trybom. New synonym, Bagnall (1913a); reestablished as full genus, Bagnall (1913b); resynonymized, Bagnall (1926).]

Spathiothrips Richter, Deutsch. Ent. Zeitschr. H. 1: 32. 1922. [Genotype by subsequent designation of Priesner (1949), *Spathiothrips bischoffi* Richter New synonymy, Bagnall (1931).]

Aeolothripoids with extremely elongate third antennal segments having long linear sensoria subdivided or nearly subdivided by short subdermal rods; with head when closely fitted against the prothorax, forming with the prothorax a compact elliptical mass; with forepart of head not greatly extended beyond eyes; with but three segments in the maxillary palpus, although segment 2 bears faint markings indicating divisions; and with wings relatively narrow for the family. These antlike thrips have been found in tropical or subtropical regions of North and South America, in some of the adjacent islands including the West Indies, and in Africa and Australia.

Head round to oval in shape; ventral surface of eyes more prolonged posteriorly than dorsal surface; ocelli always present, although the fore ocellus is often smaller than the posterior ones; third antennal segment elongated, at least 10 times as long as broad; sensoria of the third and fourth antennal segments linear, more or less subdivided by fine strengthening subdermal ridges, in the male these sensoria occupy the entire ventral and portions of the lateral areas of the third and fourth antennal segments; sensoria of the fifth, sixth, and seventh antennal segments peglike, extending free from their segments, the base of these sense cones oval; maxillary palpi 3-segmented, second segment of these palpi often with faint indications of about five subdivisions; labial palpi 4-segmented.

Prothorax with many small setae, no longer setae on the angles; mesosternellum (area posterior to the mesofurcal suture) fused with metasternum; all tarsi 2-segmented (see Crawford 1909, fig. 49D; not as in Back 1912, fig. 3); longitudinal and cross veins of forewings faint; wings similar to those of *Stomatothrips*.

Abdomen narrowly attached to thorax.

The remarkable ventral sensoria of the third and fourth antennal segments are found in no other kind of thrips. On both sides of the clear sensory area there appears to be a differentiated shelf extending longitudinally in a sinuate manner. This marginal area of a different texture than the granular dorsal surface possibly is covered by the sensorial membrane that extends over from the clear area. Since most of the ventral surface of the antennae is composed of the sensorial membrane, it is reasonable to suppose that the short rods extending from the shelf are for the purpose of strengthening the antennae to help keep it in a rigid shape. Proliferations of the dorsal integument toward the venter undoubtedly also serve to make the segment rigid. In Figs. 1 and 2, both dorsal views, the sensorial membranes are those areas on the lateral portions of the antennal segment; the shelf is depicted as small areas between the sublateral spines; and the dashes or short transverse lines represent the strengthening rods. These antennal segments were drawn from specimens which had been magnified by an oil immersion objective of a phase microscope. When the antennal segment of *megalops* was drawn (Fig. 3) I did not have access to a phase microscope, and I was unaware of the marginal shelf if it exists.

KEY TO ADULTS

(based in part on descriptions)

1. Females, sternum of abdominal segments 8 to 10 longitudinally divided, forming a cleft into which a sawlike ovipositor can be retracted 2

   Males, sternum of abdominal segments 8 and 9 entire, not longitudinally divided 7

2. Forewings with dark and light cross bands; some basal abdominal segments pale.. 3
   Forewings with dark border around margins; abdomen uniformly dark.....*lineatus* Hood
3. Antennal segment 4 largely or entirely pale yellow..... 4
   Antennal segment 4 brown..... 6
4. Abdominal segment 4 completely dark brown, similar in color to segments 5 to 9; abdominal segments 1 to 3 pale in apical two-thirds *tenuicornis* Hood
   Abdominal segment 4 mostly pale yellow, similar in color pattern to the preceding segments; abdominal segments 5 to 9 abruptly dark brown..... 5
5. Antennal segment 4 with brown shading at apex; antennal segment 1 pale yellow *megalops* Trybom
   Antennal segment 4 pale yellow without brown at apex; antennal segment 1 yellowish brown *variegatus* Girault
6. Abdominal segment 10 black. *fulgidus* Hood
   Abdominal segment 10 yellowish *vespiformis* Crawford
7. Forewings not continuously bordered around margins by dark band..... 8
   Forewings continuously bordered around margins by a dark band.....*lineatus* Hood
8. Antennal segments 3 and 4 dark brown, segment 3 as in Fig. 1; lateral ocelli farther apart from each other than the length of the diameter of a single ocellus, Fig. 7..*vespiformis* Crawford
   Antennal segments 3 and 4 light yellow brown, segment 3 as in Figs. 2 and 3; lateral ocelli closer to each other than the length of the diameter of a single ocellus, Fig. 8..... 9
9. Ocellar setae minute, much shorter than the length of the 1st antennal segment, not reaching the anterior margin of the fore ocellus; antennal segments 1 and 2 pale, similar to segment 3; antennal segment 4 longer than segment 3...*megalops* Trybom
   Ocellar setae long, longer than the length of the 1st antennal segment, greatly extended beyond anterior margin of fore ocellus; antennal segments 1 and half of 2 abruptly brown; antennal segment 4 slightly shorter than segment 3.....*tenuicornis* Hood

Franklinothrips vespiformis (Crawford)

Aeolothrips vespiformis D. L. Crawford, Pomona Coll. Journ. Ent. **1**: 109–110, ♀. 1909 [Type locality: Managua, Nicaragua.]

Franklinothrips vespiformis (Crawford). Back, Ent. News **23**: 75. 1912. [New combination.]

Franklinothrips vespiformis (Crawford), Williams, Trinidad and Tobago Bull. **17**: 143–144. 1918. [Description of larva.]

Franklinothrips vespiformis (Crawford), Moulton, Rev. de Ent. **2**: 464–465. 1932. [Description of ♂.]

Illustrations: Back, 1912; Crawford, D. L., 1909; Ebeling, 1950; Hood, 1915; Williams, 1918.

Franklinothrips vespiformis, the genotype and the oldest known species in the genus, is well illustrated in the literature and much described. It is the only *Franklinothrips* whose range extends northward into the boundaries of the United States. In the Nearctic region it occurs from southern Florida to southern California.

Some variation has been noted in the width of the forewing and in the color of the third antennal segment and wings, but these varying conditions have not been considered as yet in detail for interpretation of clinal or subspecific significance.

As a predator *vespiformis* is of benefit to growers of tropical fruits. Larvae have been observed by Ebeling (1950) feeding upon *Heliothrips haemorhoidalis*. Reijne (1921) reports them as natural enemies of *Selenothrips rubrocinctus*. An excellent photograph of the feeding attitude was published in Ebeling's *Subtropical entomology*. Other hosts are red spider mites, *Tetranychus yothersi* McG.; leafhoppers, *Idona minuenda* (Ball); and white flies, *Trialeurodes floridensis* Q. (Moznette, 1920). Young and adults of *F. vespiformis* are often observed on leaves of herbs, shrubs, and trees. I have found them also on grass growing in roadside ditches in Chiapas, Mexico.

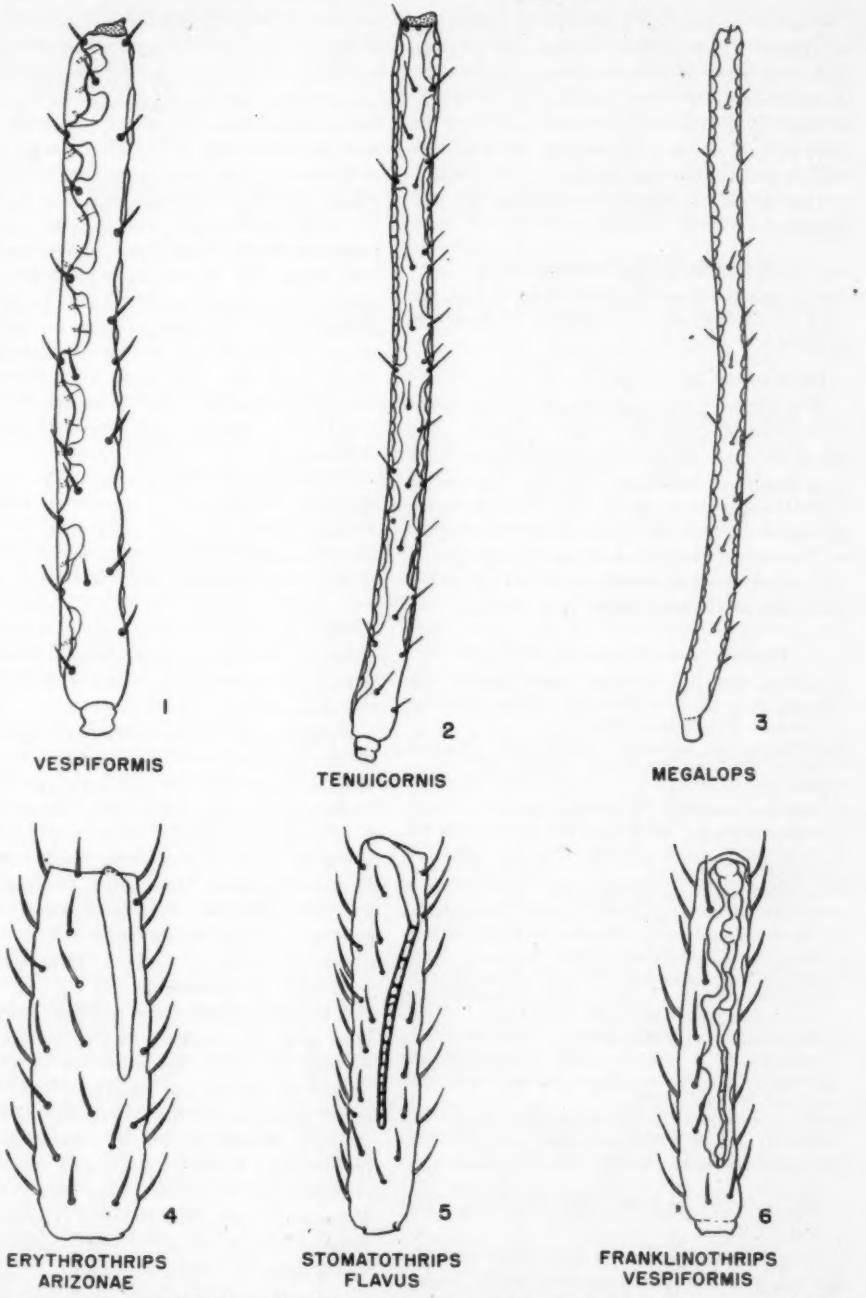
Pupal cocoons are spun on the under side of leaves (Moznette, 1920). These oval cocoons are composed of weak, loose mesh of silk several layers thick, surrounding the insect. Cocoon slides in the collection of the United States National Museum have within them either pupae or newly moulted females.

The distribution of *vespiformis* is from Brazil to southern United States, including islands of the West Indies, but apparently it is more numerous in Central America than in South America. It has been collected from the following places: Trinidad (Williams, 1918); Nicaragua (Crawford, 1909); USA: Florida (Back 1912), Texas (Hood, 1913), California (Moulton, 1929), Arizona (INHS); Panama (Hood, 1913); Cuba (Watson, 1923); Honduras (Watson and Hubbell, 1924); Mexico (INHS); St. Vincent Island, West Indies (Bagnall, 1917); Brazil (Moulton, 1932, 1938); Surinam (Reijne, 1920).

Franklinothrips fulgidus Hood

Franklinothrips fulgidus Hood, Rev. de Ent. **20**: 8–9, ♀. 1949. [Type locality: Petropolis, R. J., Brazil.]

Illustrations: Hood, 1949.



FIGS. 1–6.—1–3, *Franklinothrips*, males, third antennal segments, dorsal aspect; 4–6, Aeolothripidae, females, fourth antennal segments, dorsal aspect.

Possibly *fulgidus* is most closely related to *vespiformis*. In coloration *fulgidus* has no basal dark cross bands on abdominal segments two and three and the tenth abdominal segment is dark. In contrast *vespiformis* has dark cross bands on the basal parts of abdominal segments two and three and the tenth abdominal segment is pale yellow.

This species is known from Brazil by two females.

Franklinothrips lineatus Hood

Franklinothrips lineatus Hood, Rev. de Ent. **20**: 4–6, ♂, ♀, 1949. [Type locality: Nova Teutonia, Brazil.]

Illustrations: Hood, 1949.

This species is the only member of the genus with blackish-bordered wings without cross bands, although the male has faint indications of cross banding in addition to the black border. It is also the only species that is not bicolored on the abdomen. Instead, at least in the female, the abdomen is uniformly dark brown in pigment.

Nothing at all is known of its habits. It has been discovered just recently from Brazil.

Franklinothrips megalops (Trybom)

Mitothrips megalops Trybom, Ent. Tidskr. Arg. 33 H. 3–4: 147–151, ♂. 1912. [Type locality: Kibwezi, British East Africa.]

Franklinothrips megalops (Trybom), Bagnall, Trans. 2d Ent. Congress (1912): 397. 1913. [New combination.]

Mitothrips megalops Trybom, Bagnall, Journ. Econ. Biol. **8**: 157–158. 1913 [Reconsidered, transferred from *Franklinothrips* back to original *Mitothrips*.]

Franklinothrips myrmicaeformis Zanon, Atti Pontifica Accad. Sci. Nouvi Lincei **77** (separate): 4–9, ♀. 1924. [Type locality: Bengasi, Libya. New synonym, Bagnall, 1927.]

Franklinothrips megalops (Trybom), Bagnall, Ann. Mag. Nat. Hist. **17**: 170. 1926. [Reconsidered, combined again with *Franklinothrips*.]

Spathiothrips bischoffi Richter, Deutsch Ent. Zeitschr. H. 1: 33, ♀. 1928. [Type locality: Kwarangiva, German East Africa. New synonymy, Bagnall, 1931.]

Franklinothrips aureus Moulton, Ann. Mag. Nat. Hist. **17**: 496–497, ♂ (erroneously given as ♀ in original description). 1936. [New synonymy.]

Illustrations: Richter, 1928; Trybom, 1912; Zanon, 1924.

This African species has been illustrated, described, and discussed frequently under several names. Bagnall (1915, 1926) and Richter (1928) were the only two thysanopterists who possibly recognized its close relationship to *F. tenuicornis*, a South American species. While neither of these authors always used the name *tenuicornis*, or even necessarily the name *megalops*, they did place the two entities together to form a group distinct from *vespiformis*. The recent discovery of the male of *tenuicornis* now permits, with reasonable certainty, the conclusions that both of these species, *megalops* and *tenuicornis*, are very similar in all respects and both are more different from *vespiformis* than either is from the other.

Possibly the Australian *variegatus*, another member of the *megalops-tenuicornis* group, is the closest relative of *megalops*. However, since there are no known males of *variegatus* for comparative studies and since the single type specimen of *variegatus* is probably deformed, the exact relationship of *megalops* and *variegatus* cannot be determined.

My suspicion that *aureus* was based on a male specimen rather than a female as stated by Moulton (1936) was substantiated by Dr. China, who examined the unique type for me. Dr. China stated that the type slide had been labelled "= ♂ of *F. megalops*" by Mr. F. Laing.

The preceding key and the discussion under the section of phylogeny present points for the recognition of this species as well as evidence used in placing it near *tenuicornis* in the genus.

Measurements of the antennae given in several of the descriptions and measurements I have made indicate some regional variation. If all the measurements and statements are correct, the fourth antennal segment of the male varies from about two times as long as the last five segments combined to nearly three times the length of the last five segments. Average antennal segment lengths of females of *megalops* and *tenuicornis* are similar to each other, but both differ considerably from their respective males.

Like other *Franklinothrips* whose habits have been observed, *megalops* is also predatory. Dr. Ebeling has called my attention to an article written by Avidov and Ben-Haim in which they report *megalops* (under the name *myrmicaeformis*) as being natural enemies of *Heliothrips haemorrhoidalis* and *Retithrips syriacus* in Israel.

Collections of *megalops* have been made from Kibwezi, British East Africa (Trybom, 1912); Bengasi, Libya (Zanon, 1924); German East Africa (Richter, 1928); Mossel Bay, Cape Province, South Africa (Bagnall, 1927, and Moulton, 1930); and Paoli, Italian Somaliland (material borrowed from H. Priesner).

Franklinothrips tenuicornis Hood

Franklinothrips tenuicornis Hood, Ent. News **26**: 164–165, ♀. Mailed Mar. 31, 1915. [Type locality: Moro Island, Panama.]

Mitothrips petulans Bagnall, Linn. Soc. Journ. **32**: 496–498, ♀. Sept. 1915. [Type locality: Sangre Grande, Trinidad. New synonymy, Bagnall, 1926.]

Franklinothrips tenuicornis Hood, Williams, Trinidad and Tabago Bull. **17**: 1440. 1918. [Description of larvae.]

Spathiothrips petulans (Bagnall), Richter, Deutsch Ent. Zeitschr. H. **1**: 33–37. 1928. [New combination of synonym.]

Franklinothrips petulans (Bagnall), Moulton, Rev. de Ent. **2**: 465. 1932. [New combination of synonym.]

Illustrations: Bagnall, 1915; Hood, 1915; Reijne, 1920.

Contrary to the contention made by Hood (1915) *tenuicornis* is most closely allied morphologically, character by character, to *megalops* rather than to *vespiformis*. Comparisons of these species are made in the section on phylogeny. Shared in common with *vespiformis* are areas of the range of *tenuicornis* since both species occur in Trinidad, Surinam, and Panama, and possibly in other parts of South America. Unlike *vespiformis*, *tenuicornis* does not extend into Central America.

Description of male: Length distended about 1.7 mm. Body generally brown with much red to purplish-red subintegumental pigments; abdominal segments 2 and 3 and tibiae, pale yellow; apices of femora light brownish yellow; tip of abdomen orange-yellow; antennal segments 1, base of 2, and all of 5 to 7 brown concolorous with head; tip of antennal segment 2, and all of segments 3 and 4 light brownish yellow; ocellar pigments crimson; forewings with three brown bands, one near base, one just beyond the middle and one at the tip of the wing; forewing scale possibly brownish.

Head oval with large eyes and ocelli, with long interocellar setae, as in Fig. 8; antennal segments 3 and 4 with elaborate sensoria, finely divided by numerous ridges as in Fig. 2; segment 3 slightly longer than segment 4. Maxillary palps 3-segmented with almost no indications of subdivision marks in the second segment.

Prothorax slightly narrower than head width.

Abdomen unadorned by clasperlike processes as found in some males of *Aeolothrips*.

Described from a male collected in a light trap at Madden Dam, Panama Canal Zone, on February 1, 1946, by Dr. Eliot Williams.

Both C. B. Williams (1918) and Reijne (1920), have noted that the habits of *tenuicornis* are similar to those of *vespiformis*. Larvae of *tenuicornis* actually have been observed feeding on *Selenothrips rubrocinctus*, the Cacao thrips. An interesting account of the cocoon making activities of *tenuicornis* was given by Reijne in 1920. According to this author, the prepupal stage does not occur; instead the larva passes directly into the pupal form.

F. tenuicornis has been found in the following regions: Trinidad (Bagnall, 1915; Williams, 1918); Panama (Hood, 1915); Peru (USNM); Surinam (Reijne, 1920); Venezuela (Moulton, 1932); Brazil (Moulton, 1932, 1938).

Franklinothrips variegatus Girault

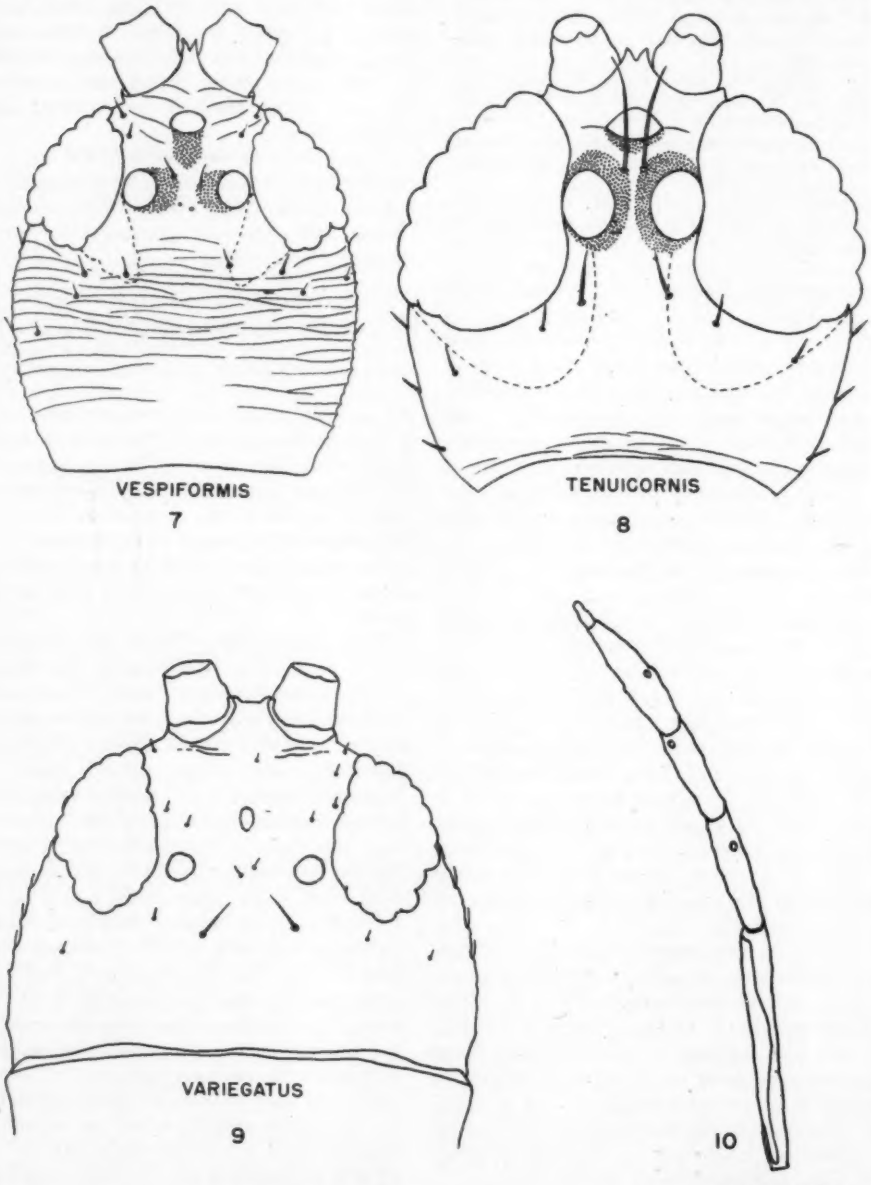
Franklinothrips variegatus Girault, Brisbane, Private publication, ♀. 1927. [Type locality: Brigalow, Jandowae, Queensland, Australia.]

In coloration and in structure *variegatus*, (Fig. 9) is most similar to the African *megalops*. Unlike *megalops* the legs of *variegatus* are darker; the first antennal segment is darker, lightly shaded with brown; the fourth antennal segment is entirely light yellow, nearly white, without brown at the apex; and the fourth antennal segment is slightly longer in proportion to the third segment in the female.

Both antennal segments are detached beyond the third segment in the type slide. The detached portion of one antenna lies to the side under the cover slip; the remainder of the other antenna is missing. Most probably the present portion is of a deformed antenna because segments 7 and 8 are completely fused (Fig. 10). Such deformities are not uncommon in the Thysanoptera. It seems unwise, therefore, to characterise this species as "having each antenna with but eight segments" on the basis of this one fragment.

Girault, in his original description, stated: "Antennal 3 elongate, 5–7½ + 4 which is shorter than 3." By this remark Girault most likely meant that the length of segments 5, 6, and 7 together is 1½ times longer than the segment 4 and that segment 4 is shorter than segment 3. To arrive at such a conclusion Girault must have considered the fused seventh and eighth segment and the small ninth segment as one, the seventh segment. Acutally the suture setting off the ninth segment is difficult to see in Girault's slide preparation. By this interpretation, even though incorrect, the combined length of segments 5, 6, and 7 is 1½ times longer than the fourth. Some

time later Kelly and Mayne (1934) reworded Girault's remarks to state that the combined length of segments 5, 6, and 7 is equal to half the length of 4. Their rewording is in error, not only in the interpretation of Girault's meaning but also in fact. The combined length of segments 5, 6, and 7, whether the seventh is the "deformed" fused seventh and eighth, or the morphological



FIGS. 7–10.—7, 8, *Franklinothrips*, males, heads, dorsal aspect; 9, 10, *Franklinothrips variegatus*: 9, Head, dorsal aspect, holotype; 10, outline of "deformed" antennal portion, holotype.

seventh segment, measured to the fusion line, is either slightly longer than the fourth, or very much longer than the fourth segment.

Although described nearly a quarter century ago, presumably the type specimen, captured February 17, 1924, remains the only known representative of this species. It is the sole species of *Franklinothrips* in Australia.

PHYLOGENY

Guide points for the initial plotting of the phylogeny are more apparent in certain male structures in this genus. Variations in the shape of the third and fourth antennal segments and their sensorial areas and the head outline are more markedly different between the males than between the females. Since these differences range from one type to another, a progression can be set up using any extreme as the starting place. After these characters have been correlated to establish the progressive trend, relationships of both ends of the trend (most like the prototype or most divergent) can be determined by associating these ends with the rest of the family. Such a procedure was followed in determining what could be surmised of the phylogeny of *Franklinothrips*. Because two of the species are unknown in the male sex, only *megalops*, *tenuidornis*, *vespiformis*, and *lineatus* were considered for exact relationships.

Figs. 1 and 2 of the third antennal segment illustrate the greatest divergence in antennal types. The fourth segment resembles the third except that it differs in size. In *vespiformis* the third segment is shorter and wider than in its congeners, and the sensorial membrane is less subdivided by ridges. On the other hand, *tenuicornis* and *megalops*, both similar to each other, have a more slender and longer third and fourth segment, and the sensoria have many numerous ridges subdividing them. Possibly near the latter extreme is the antennal type found in *lineatus*. Although Hood in 1949, called the sensoria of *lineatus* colorless and reticulated ventral and lateral areas, his drawing of the fourth antennal segment shows that this colorless region is that part of the antennae that is referred to here as a sensorium. In some respects the sensoria of *lineatus* are more like *tenuicornis* and *megalops* in the fourth segment and presumably also in the third segment.

Two types of head outlines exist in the males. The oval-shaped head with relatively smaller compound eyes, as in *vespiformis* (Fig. 7), differs from the round head and relatively larger compound eyes of *megalops* and *tenuicornis* (Fig. 8). Again, compared with Hood's illustrations, the head of *lineatus* appears to be intermediate between the round and oval types. The *lineatus* head is oval but the eyes are proportionately larger than those of *vespiformis*, approaching more closely the eye shapes found in *megalops* and *tenuicornis*.

By so sorting these several characteristics and correlating them, the empirical phylogenetic tree shown in Fig. 11, is suggested. The species *fulgidus* and *variegatus* are placed on this tree solely on the basis of color similarities.

Whether the genus originated as a form similar to *vespiformis* or instead similar to *megalops*, or even by a form intermediate to these two, possibly like *lineatus*, is the next aspect to be considered. To attempt determination of this starting point it is necessary to examine the family Aeolothripidae of which *Franklinothrips* is a part.

When the extremes of some characteristics of many species of the family Aeolothripidae were established and intermediate types plotted between the extremes, a sort of rectilinear progression was noted. A very

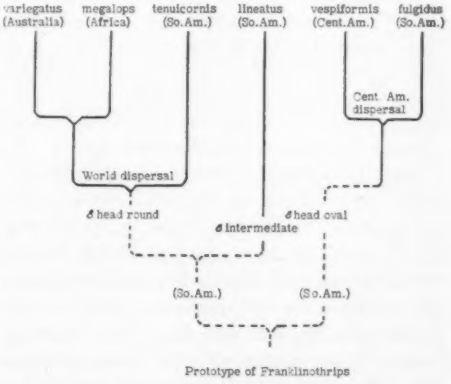


FIG. 11.—Family tree of the genus *Franklinothrips* showing possible historical distribution.

gradual progression occurs from short to long third and fourth antennal segments, from small circular to elongate linear third and fourth antennal sensoria, from pupation in the soil to pupation on leaves, and from flower inhabitors to roving predators.

Franklinothrips finds its place in this scheme at one extreme end of its family. This genus represents that end of the progression having the longest third and fourth antennal segments, having the most elaborate elongate sensoria on these two segments, besides being predators and using leaves for pupation sites.

The species *tenuicornis* and *megalops*, because they possess the longest third and fourth antennal segments with the most subdivisions in the sensoria of these segments, would be the most extreme forms of the genus and of the family. Therefore, it is reasonable to presume that either *lineatus* or *vespiformis* both having less elaborately formed antennae are closer to the prototype than is the *megalops* group. Because I have not had the opportunity to examine a male of *lineatus* I am unable to continue the analysis to decide whether *Franklinothrips* arose from a *lineatus*-like species or a *vespiformis*-like species. However, it seems probable that both *lineatus* and *vespiformis* are specialized themselves and that the ancestor of the genus, while near the latter two species, was even more primitive. This ancestor could have been a *Stomatothrips* derivative.

Development of the peculiar sensoria of the *Franklinothrips* can be traced from clues derived from living forms. Figs. 4, 5, and 6 show the sensoria of females in three genera. A progression goes from the smaller linear type in *Erythrothrips* to the more elongated sensoria of *Stomatothrips* to the extremely elongated form in *Franklinothrips*. Faint indications of sensorial subdivisions first appear in *Stomatothrips*. A broadening of the sensoria to cover the entire surface of the third and fourth antennal segments has evolved in the male sex only of the *Franklinothrips* whereas the *Franklinothrips* female has preserved the *Stomatothrips* type more closely. *Euceratothrips* Hood, another aeolothripid, likewise has elaborate sensoria, but, while similar in some respects to the sensoria of *Franklinothrips* males, the sensoria of *Euceratothrips* is formed in a different manner (see Hood, Rev. de Ent. **6**: 425–429, 1936).

In North America, the closest relative of *Franklinothrips* is *Stomatothrips*. In addition to the similarities in the sensoria, both have narrow wings, slightly broader at the apex; their maxillary palpi are somewhat the same, although in *Stomatothrips* the third segment is usually completely subdivided several times whereas only indications of subdivision are usual in *Franklinothrips*; and even the habits of the two may be similar for I have collected species of each of these genera from ecological niches that are grossly the same.

Corynothripoides Bagnall, in most classifications, is placed with *Franklinothrips* in the tribe Franklinothripini. Whether *Corynothripoides* is closer to *Franklinothrips* than to *Stomatothrips* on all characteristics is not clear to me. I have never seen *Corynothripoides* nor do the descriptions of this genus include information on the condition of all of the characters that I have studied in *Stomatothrips* and *Franklinothrips*.

NOMENCLATORIAL REMARKS

Three species, now in other genera, have been assigned to *Franklinothrips* for a brief time. Should names be designated subsequently to true *Franklinothrips* which are identical to the names of these three species, the thorny problem of secondary homonyms might be raised. Most certainly, circumvention of such difficulties by the avoidance of these names would be an advantage.

The three species involved are listed below with references. These names would best not be used again in *Franklinothrips*.

Franklinothrips insularis (Franklin):

Franklinothr. insularis (Fr.). Girault, New pests from Australia, VIII. Private publication, Brisbane, Aug. 16, 1930. [Misstatement for *Frankliniella insularis* Franklin. Corrected by Girault Dec. 29, 1930, in "New pests from Australia, IX," Brisbane.]

Franklinothrips longiceps (Crawford):

Franklinothrips longiceps (Crawford), Bagnall, Trans. 2nd Ent. Congress (1912): 397, 1913. [New combination from *Aeolothrips*. Reassigned to *Aeolothrips*, Hood, 1915.]

Franklinothrips nasturtii (Jones):

Franklinothrips nasturtii (Jones), Bagnall, Trans. 2d Ent. Congress (1912): 397, 1913. [New combination from *Aeolothrips*. Reassigned to *Aeolothrips*, Hood, 1915.]

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ZOOLOGY.—*A new genus and species of Limnadiidae from Venezuela (Crustacea: Conchostraca).* N. T. MATTOX, College of Agriculture and Mechanic Arts, Mayagüez, Puerto Rico.[1] (Communicated by F. A. Chace, Jr.)

While making collections for the Venezuelan Scientific Expedition conducted by the University of Puerto Rico, one of the collectors, Jenaro Maldonado Capriles, observed many temporary rain pools which contained conchostracan phyllopods. One collection of 10 males and 11 females was made in a rock pool near Samariapo, Venezuela, on June 11, 1950. According to Mr. Maldonado, these animals were very abundant and many pools were inhabited by them, but only one collection was made. Study of these animals indicated that they are members of the family Limnadiidae but are intergeneric in character and referable to a distinct and previously undescribed genus.

[1] Contribution from the Department of Biology, College of Agricultural and Mechanic Arts University of Puerto Rico, Mayagüez, P. R.

Metalimnadia, n. gen.

Generic designation.—Conchostracan phyllopods with 7 to 13 lines of growth in the adult, and a prominent anteriorly located umbo on the shell. Head without fornice: the prehensile frontal organ rudimentary and not pyriform. First antennae with two segments. Occipital notch prominent. Sixteen pairs of swimming appendages; first two pairs of male with prehensile claws; female ninth and tenth pairs with very long epipodite of exopodite for bearing eggs. Inferior, distal angle of telson with a small spine. The

posterior 15 of the body segments bear one or more dorsal spines.

Genotype: *Metalimnadia serratura*, n. sp.

Metalimnadia serratura, n. sp.

Description.—Male: The male shell is elongate oval with a prominent umbo at one-fifteenth of the distance from the anterior margin (Fig. 1a). The number of lines of growth varies from 11 to 13, with much crowding at the anterior end of the shell. The dorsal margin is straight except at the posterior slope of the shell; the ventral margin is regularly rounded. The size of the adult shell averages 5.88 by 3.66 mm, varying from 5.5 mm long by 3.7 mm wide to 6.0 by 3.8 mm; the greatest height is just posterior to the middle. The height-length ratio averages 1:1.54.

The head presents definite generic and specific characters (Fig. 1b). The dorsal "frontal organ" is very rudimentary, being raised only slightly as a rounded knob with a central concavity. The front of the head is deeply concave with the rostrum extending in a very pronounced hooklike beak. The first antennae are distinctive in that they have two segments, the distal one clavate. The second antennae are biramous, each branch with nine segments and each segment with a varying number of long, dorsal spines. The occipital notch is prominent. The ocellus is very pronounced.

The body bears 16 pairs of swimming appendages. The first and second pairs are modified into typical claspers. The claspers of the first pair are very broad; the fourth endite has a short knoblike lateral extension, and the two segments of the sixth endite are approximately of equal length (Fig. 1c). The claspers of the second pair are more slender; the terminal segment of the sixth endite is approximately 1.5 times longer than the first segment (Fig. 1d). The exopodites on both pairs of claspers are very short. The branchiae, as on the other appendages, are broad.

The dorsal surface of the first body segment is bare; the other segments bear 1 to 5 dorsal spines, those on the posterior segments being longer and more slender (Fig. 1e). An example of a typical spine formula is: 0–1–2–2–2–3–3–4–4–4–5–4–4–3–1–1. The telson is very truncate. The dorsal ridges of the telson are regularly serrated with an average number of 12 evenly spaced and pronounced sawtoothlike spines; a biramous filamentous spine arises between the third and fourth dorsal spines. The pair of ventral, posterior, movable spines have bristlelike spines on the proximal portion with microspines on the sharply attenuated terminal portion. On the inferior distal margin of the telson is a small spine.

Female: The female shell is similar to, but smaller than, that of the male. It is more ventricose and more rounded on the dorsal margin than in the male (Fig. 1f). The umbo is less pronounced and there is a median, shallow indentation on the ventral margin. The usual number of growth lines is 10, with a variation from 7 to 10. In size the female shell averages 4.94 mm long by 3.39 mm in height. The variation in the 11 females is from 4.5 mm by 3.0 mm to 5.4 by 3.5 mm. The height-length ratio is 1:1.45.

The head of the female is smaller and less elongate, but similar to that of the male. The front is deeply concave, the rostrum beaklike. The ocellus is very pronounced, the frontal organ very rudimentary, and the first antennae 2-segmented (Fig. 1h).

The 16 pairs of trunk appendages are swimming legs typical of the group. The first pair have well marked endites; the sixth endite extends about to the end of the fifth endite (Fig. 1i). The branchiae, as in the male, are very broad. The ninth and tenth pairs of legs possess a greatly extended basal exopodite flabellum for the attachment and carrying of eggs; this flabellum is twice as long as the length of the rest of the appendage (Fig. 1j). The eggs are spherical, with rough surface, and average 0.3 mm in diameter (Fig. 1g). The dorsal ridges of the trunk segments are variously spined as in the male, and the telson is similar to that of the male.

Type locality.—Samariapo, Territorio Amazonas, Venezuela.

Types.—Holotype, male, U.S.N.M. no. 92292, and paratypes, both sexes, U.S.N.M. no. 92293, in the U. S. National Museum and in the writer's collection.

Remarks.—*Metalimnadia serratura* differs from other members of the family Limnadiidae in so many characters as to nearly warrant a subfamily or separate family designation. However, the general form of the body, number of trunk appendages, form of the telson, and the first two pairs of male claspers, find closer resemblance in the Limnadiidae than in any of the other conchostracan families. Many of the other morphological characters, however, are very different from those of other Limnadiidae.

The shell of *M. serratura* is more estheriidlike than it is like the shells of the other Limnadiidae. No member of the genus *Eulimnadia* has as many growth lines or an umbo as well developed. In *Limnadia*, only the male of *L. stanleyana* King from Australia has a shell with a well-pronounced

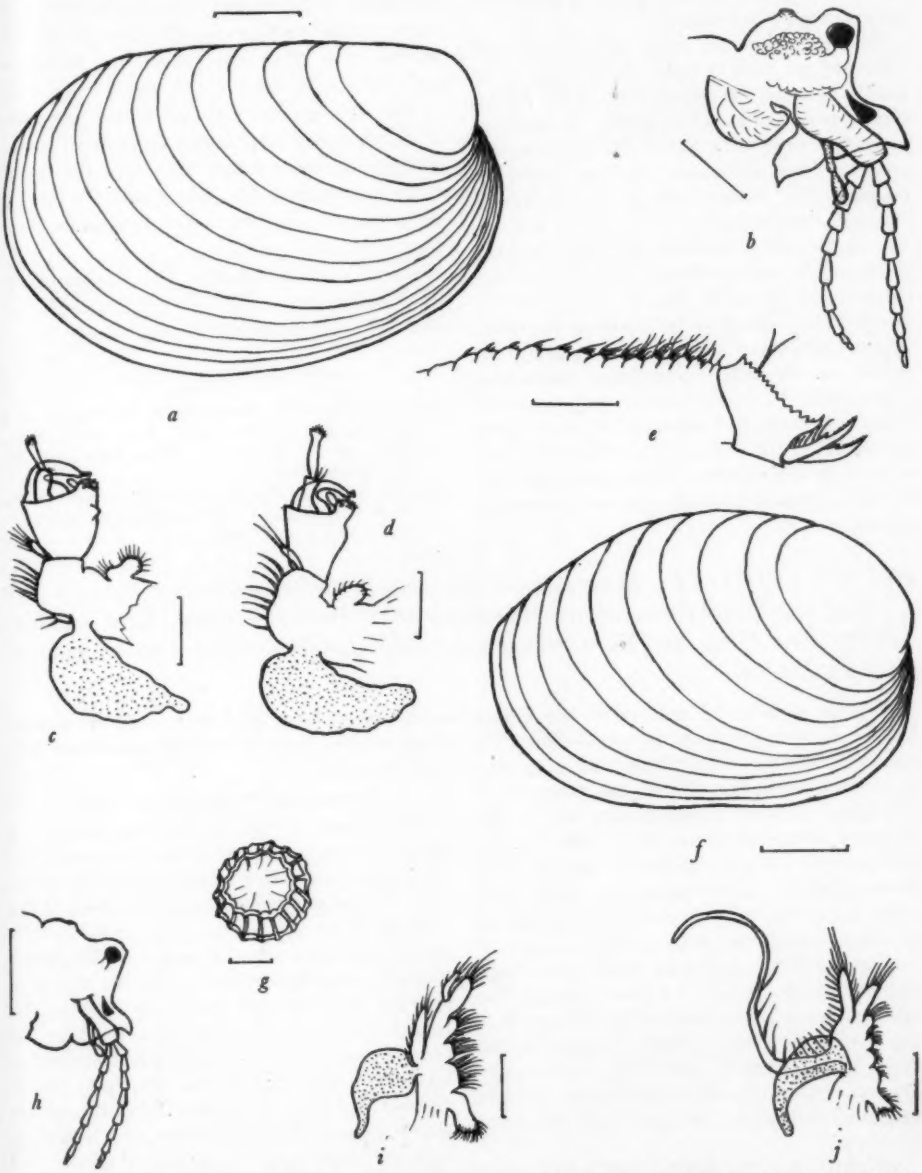

FIG. 1.—*Metalimnadia serratura*, n. gen., n. sp. *a–e*, male: *a*, Lateral view of shell; *b*, lateral view of head; *c*, first pair of claspers; *d*, second pair of claspers; *e*, lateral view of trunk and telson. *f–j*, female: f, Lateral view of shell; *g*, an egg; *h*, lateral view of head; *i*, a first trunk appendage; *j*, tenth trunk appendage. Scales a, b, e, f, h equal 1 mm; c, d, i, j equal 0.5 mm; g equals 0.1 mm.

umbo and as many lines of growth. The female of this latter species has a very different shell. All species of *Limnadiopsis*, the other genus of the family, are unique in having a very noticeably serrated dorsal shell margin.

The head characters of *M. serratura* are very different from those of the other members of the family, although the general form of the head is similar to that of the other genera. As indicated by Daday (1915, 1925) the Limnadiidae are characterized by a prominent, pyriform frontal appendage. This frontal organ in *M. serratura* is very rudimentary, not pyriform, and it is raised only slightly above the dorsal surface of the head. What may be the evolutionary status of this very characteristic limnadiid feature among the different genera cannot be indicated at this time. The first antennae of all the other members of the family are elongate, unsegmented appendages with a series of dorsally located sensory papillae. The 2-segmented first antennae of *M. serratura* are more like those of the Lynceidae than any other of the Conchostraca. These appendages are strongly diagnostic for the present genus and species.

As pointed out by Linder (1945) many species of *Limnadia* have only 16 pairs of trunk appendages, as does *M. serratura*. Other members of the family may have up to 32 pairs. The first two pairs of male claspers are characteristic, but, as on the other trunk appendages, the branchiae are much larger and proportionately wider than in the other genera. The egg-bearing exopodite of the ninth and tenth female appendages is proportionately much longer than typically found in the Limnadiidae. The telson, with the inferior distal spine, is more like that of *Eulimnadia*, than that of the other genera.

It seems as if this species, *Metalimnadia serratura*, represents a newly found intergeneric line of evolution in the family Limnadiidae.

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HELMINTHOLOGY.—*Some cestodes from Oregon shrews, with descriptions of four new species of* Hymenolepis *Weinland, 1858*.

BETTY LOCKER, Reed College, Portland, Oreg., and ROBERT RAUSCH, Arctic Health Research Center, Anchorage, Alaska.

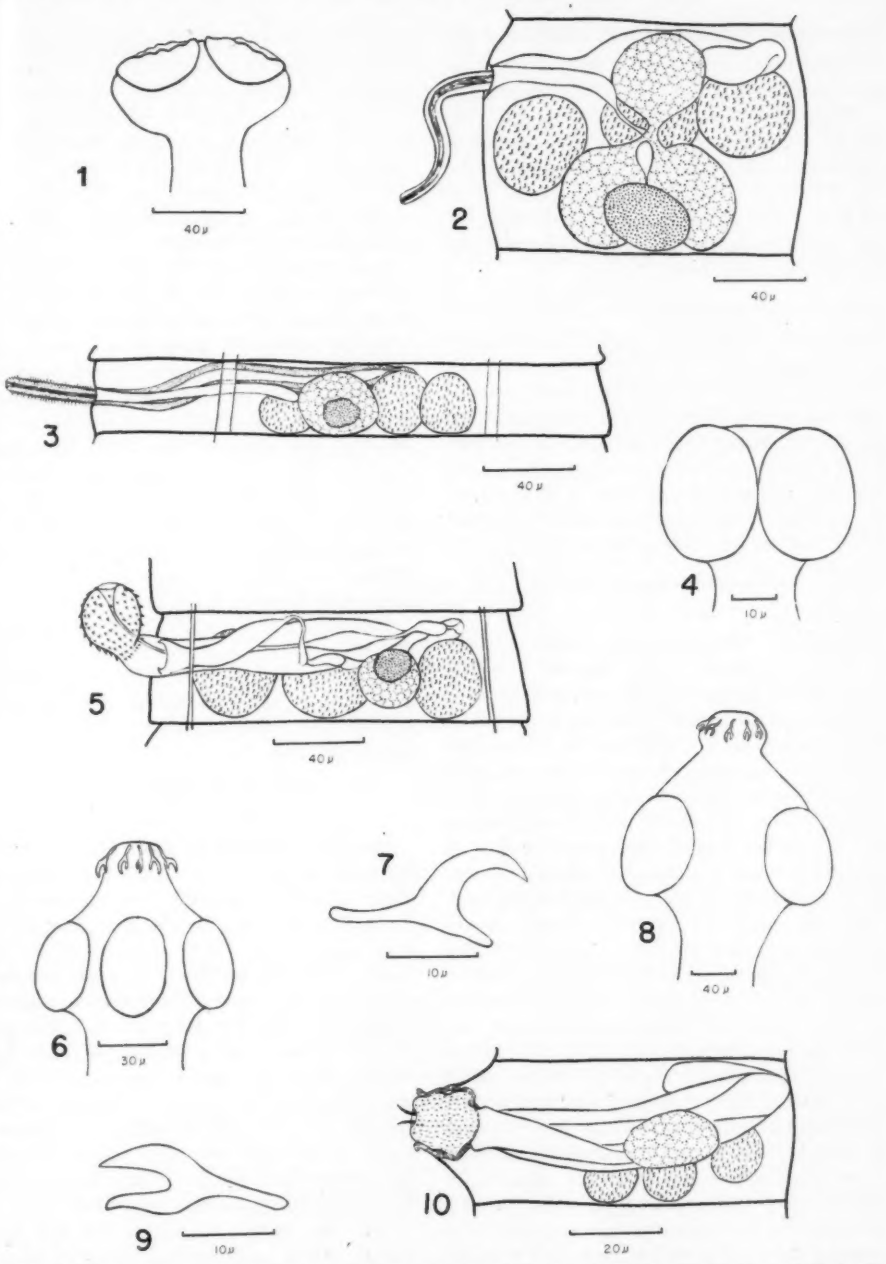
A large number of shrews of the genus *Sorex* has been examined in connection with the investigation of the helminth parasites of Oregon mammals. It is the purpose of this paper to give a preliminary list of the cestodes obtained from these shrews, together with the description of new species. More complete information on these and other helminths will be published by one of us (B. L.) at a later date.

The helminths reported here have been collected from *Sorex v. vagrans* Baird, the most common shrew of western Oregon during the time these collections were made. Host determinations were made by comparing our material with specimens in the mammal collections of the U. S. National Museum.

In addition to the species herein described, we have also recorded three previously described cestodes from Oregon shrews. These observations appear to be the first to be made on cestodes in shrews from the Pacific coast region. Each species is considered separately below.

Protogynella blarinae Jones, 1943

This minute cestode of uncertain status was found to occur commonly in Oregon shrews. The Oregon specimens were not considered in detail, since another worker has already undertaken the restudy of the species; however, as far as was determined these cestodes were morphologically identical with those found in shrews (*Sorex c. cinereus* Kerr; *Blarina brevicauda* Say) in the eastern States. It was noted, however, that the Oregon specimens had a much larger number of hooks than was reported from Wisconsin shrews (Rausch and Kuns, 1950). Because of the minute size and proximity of these rostellar hooks, an accurate count was impossible; however, the number is near one hundred. Whether or not this represents only variation can be determined on the basis of the study of specimens from different geographical locations.



FIGS. 1–10.—1, Scolex of *H. macyi*; 2, mature segment of *H. macyi*; 3, mature segment of *H. kenki*; 4, scolex of *H. kenki*; 5, mature segment of *H. sphenomorphus*; 6, scolex of *H. sphenomorphus*; 7, rostellar hook of *H. sphenomorphus*; 8, scolex of *H. intricatus*; 9, rostellar hook of *H. intricatus*; 10, mature segment of *H. intricatus*.

Hymenolepis falculata Rausch and Kuns, 1950

Although not a common species when compared with some of the other cestodes occurring in Oregon shrews, *H. falculata* was collected frequently. This is perhaps the most common species occurring in *Sorex cinereus* in southern Wisconsin, but it has not yet been recorded from other localities. The specimens examined from *S. vagrans* were morphologically identical with material from the type locality.

Hymenolepis schilleri Rausch and Kuns, 1950

The study of abundant material from Oregon shrews has allowed some further observations on the morphology of *H. schilleri*, which so far is known only from the two specimens upon which the original description was based. It has been found that the number of rostellar hooks is variable, and a maximum number of 32 has been recorded. In regard to other morphological characters, the original description is adequate.

Hymenolepis macyi, n. sp.

Figs. 1, 2, 11

Diagnosis.—Hymenolepididae. Strobila length up to 2 mm; greatest width, attained in gravid segments, 500μ. Strobila characterized by relatively large size of gravid segments, up to 500 by 250μ. Transition from immature to mature segments, and from mature to gravid segments, very abrupt; this results in tripartite appearance of strobila. There are usually 4 to 6 segments in each (immature, mature, and gravid) section of strobila, with maximum possible segment number about 18. Immature and early mature segments wider than long; late mature segments nearly square; gravid segments oval. Scolex 180 to 230μ in diameter, strongly set off from neck; rostellum absent. Suckers oval, about 100μ long. Genital pores unilateral and dextral, situated near anterior end of margin of segment. Cirrus sac, as much as 400μ long by 70μ wide, extends nearly across mature segment to anterior aporal corner. Cirrus unarmed. External seminal vesicle strongly developed. Testes in mature segments measure about 35μ in diameter, and are situated in diagonal row with aporal testis most anterior. Vagina, about 8μ in diameter in mature segments, situated ventral to cirrus sac; it narrows abruptly just poral to ovary. Seminal receptacle not noted. Ovary trilobed, situated near center of segment; two lobes posterior and one anterior. Ovarian lobes subspherical, each about 30μ in diameter in mature segments. Vitelline gland on midline of segment at posterior edge of ovary, and ventral to it. Development of uterus abrupt; gravid segment capsulelike, with thick parenchyma around egg-filled uterus. Genital ducts persist in terminal segments. Eggs spherical, from 30 to 32μ in diameter.

Host.—*Sorex v. vagrans* Baird.

Type locality.—Portland, Oreg.

Habitat.—Small intestine.

Type.—A slide containing an entire specimen has been deposited in the Helminthological Collection of the U. S. National Museum, no. 47531.

Hymenolepis macyi appears to be well characterized by the unusual gross appearance of the strobila, and can be differentiated on this basis from the other unarmed soricid species of *Hymenolepis* (*H. alpestris* Baer, 1931; *H. anthocephalus* Van Gundy, 1935; *H. diaphana* Kholodkowski, 1906; *H. globosa* Baer, 1931; *H. minuta* Baer, 1926; *H. soricis* Baer, 1925). It can be further differentiated on the basis of cirrus sac position and size, arrangement of testes and ovary, and egg size.

This cestode is named in honor of Dr. Ralph W. Macy, chairman, department of biology, Reed College, Portland, Oreg. This opportunity is taken to express appreciation of his providing facilities and working space in connection with part of this work.

Hymenolepis kenki, n. sp.

Figs. 3, 4, 12

Diagnosis.—Hymenolepididae. Strobila 1 to 2 mm long; greatest width, attained in gravid segments, slightly over 200μ. Strobila consists of about 50 segments, all wider than long with a slight relative increase in length in gravid segments. Scolex 280 to 340μ in diameter; rostellum absent. Suckers strongly developed, elliptical, about 180μ long. Genital pores unilateral and dextral, situated near middle of segmental margin. Cirrus sac, usually about 100μ long by about 20μ wide in mature segments, extends aporally to just beyond midline of segment. Cirrus thickly set with fine spines. External seminal vesicle present. Testes spherical, about 30μ in diameter in mature segments; situated in straight line with two aporal and one poral. Vagina ventral to cirrus sac; diameter uniform and course direct as far aporal as poral margin of ovary. Seminal receptacle not evident. Ovary subspherical, about 30μ in length, situated near midline of segment. Vitelline gland ventral to ovary. Uterus appears early in strobila as spheri-

cal body which gradually enlarges to fill entire gravid segment. Eggs apparently spherical, 19 to 22μ in diameter; fully-developed eggs in terminal segments highly distorted by fixation in all available material.

Host.—*Sorex v. vagrans* Baird.

Type locality.—Portland, Oreg.

Habitat.—Small intestine.

Type.—A slide containing paratype material has been deposited in the Helminthological Collection of the U. S. National Museum, no. 47532.

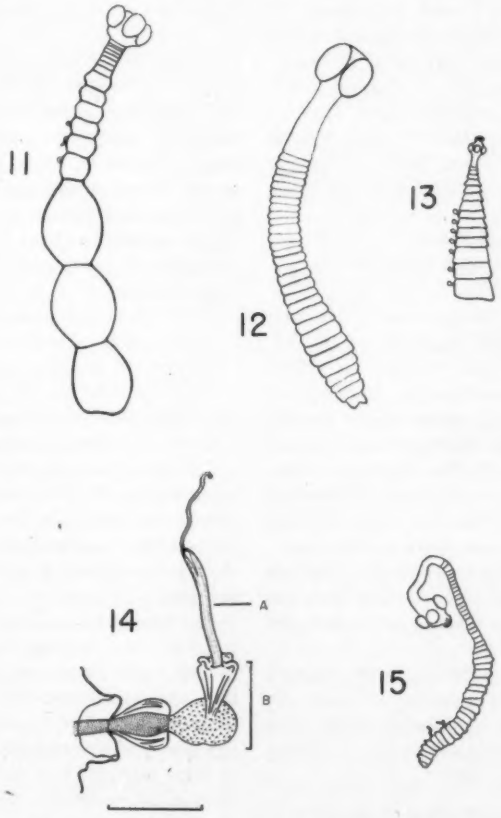
On the basis of testes arrangement (straight line) as well as by other morphological characters, *H. kenki* can be differentiated from the soricid species of *Hymenolepis* which have the testes arranged in a triangle (*H. anthocephalus* Van Gundy, 1935; *H. alpestris* Baer, 1931; *H. diaphana* Kholodkowski, 1906; *H. globosa* Baer, 1931). It may be differentiated from *H. minuta* Baer, 1926, and from *H. soricis* Baer, 1925, which also have the testes arranged in a straight line, by size and relative length of cirrus sac, by egg size (?), and other morphological characters. However, *H. soricis* is poorly known, and *H. minuta* was described on the basis of an immature specimen.

This cestode is named in honor of Dr. Roman Kenk, of Washington, D. C.

Hymenolepis sphenomorphus, n. sp.

Figs. 5–7, 13

Diagnosis.—Hymenolepididae. Strobila length up to 800μ; greatest width, attained in terminal segments, about 200μ. Wedge-shaped strobila of



FIGS. 11–15.—11, Entire strobila of *H. macyi*; 12, entire strobila of *H. kenki*; 13, entire strobila of *H. sphenomorphus*; 14, semidiagrammatic drawing of cirrus (A) and vagina (B) of *H. intricatus*, showing attachment; 15, entire strobila of *H. intricatus*. (Figs. 11, 12, 13, and 15 all drawn to same scale with the aid of a projector.)

characteristic gross appearance. Segments, about 15 in number, wider than long; they become relatively longer when gravid. Strobila margins serrate. Scolex 90μ in diameter, distinctly set off from neck. Rostellum well developed, armed with 10 hooks 16 to 20μ long. Suckers elliptical, about 45μ long. Genital pores unilateral and dextral, situated near middle of margin of segment. Cirrus sac attains length of 110μ and width of 25μ in mature segments, and extends aporally beyond midline of segment. Cirrus strongly developed, and furnished with spined terminal knob 30 to 32μ in diameter. External seminal vesicle present. Subspherical to ovoid testes about 35μ in diameter in mature segments; testes arranged in straight line, with two poral to ovary, and one aporal. Thin-walled vagina ventral to cirrus sac; about 20μ in diameter near genital pore. Vagina narrows abruptly to slender duct at distance of about 60μ from poral margin of segment; small seminal receptacle formed just poral to ovary. Ovary subspherical, about 35μ in diameter, situated aporal of midline ventral to testes. Vitelline gland ovoid, situated ventral to ovary. Uterus gradually enlarges in central part of segment; gravid segments completely filled with eggs. Eggs measure 16 to 19μ.

Host.—*Sorex v. vagrans* Baird.

Type locality.—Multnomah Falls, Oreg.

Habitat.—Small intestine.

Type.—A slide containing an entire specimen has been deposited in the Helminthological Collection of the U. S. National Museum, no. 47533.

Hymenolepis sphenomorphus is characterized grossly by the very small, wedge-shaped strobila in combination with the extreme relative size of the cirrus. It is differentiated from the other soricid species which have 10 hooks (*H. blarinae* Rausch and Kuns, 1950; *H. jacobsoni* von Linstow, 1907; *H. parva* Rausch and Kuns, 1950; *H. scutigera* (Dujardin, 1845); *H. singularis* Kholodkowski, 1913) by differences in hook size and shape, size and location of cirrus sac, and character of the cirrus.

Six specimens of this cestode were obtained from a shrew captured under a log along the Columbia River near Multnomah Falls. This parasite was collected but once, and was the least common form considered here.

Hymenolepis intricatus, n. sp.

Figs. 8–10, 14, 15

Diagonsis.—Hymenolepdidiae. Strobila length 1.2 to 2 mm; greatest width, attained near middle of strobila, about 100μ. Strobila margins not serrate; all segments wider than long. Total number of segments 60 to 75. Scolex strongly developed, 160 to 180μ in diameter; distinctly set off from unsegmented neck. Rostellum well developed, armed with 10 hooks 17 to 21μ long. Suckers 90 to 100μ long. Genital pores unilateral and dextral, situated near middle of margin of segment on projection of segmental margin. Cirrus sac large, attaining length of 75 by 16μ in mature segments, and extending aporally nearly to margin of segment. External seminal vesicle well developed. Cirrus spinose and slender. Testes situated in diagonal line, all aporal of midline. Spherical testes measure about 10μ in mature segments. Vagina thin-walled, of about same diameter as cirrus sac. Terminal part of vagina highly specialized, having a bulblike, heavily spined section which adjoins a terminal, funnel-like structure whose wall is supported by several rigid spicules. This organ is capable of being extruded, and appears to function in connection with clasping during copulation. No seminal receptacle noted. Ovary subspherical, up to 20μ long in mature segments. Vitelline gland not observed. Uterus develops gradually as single body; gravid segments completely filled with eggs. Eggs ovoid, apparently about 25μ in length; accurate measurement prevented by distortion resulting from fixation.

Host.—*Sorex v. vagrans* Baird.

Type locality.—Portland, Oreg.

Habitat.—Small intestine.

Type.—A slide bearing paratype material has been deposited in the Helminthological Collection of the U. S. National Museum, no. 47534.

This species may be differentiated from related forms having 10 hooks (see above) on the basis of hook size and shape, size and position of cirrus sac and other genital organs, and particularly by the apparently unique development of the terminal part of the vagina.

The finer details of the vagina of this cestode could not be completely worked out, because of the extremely small size; however, it is evident that the vagina demonstrates a much higher degree of specialization than is ordinarily seen in the species of *Hymenolepis*. The vagina is capable of being extruded to a distance of more than 20μ behond the margins of the genital atrium, which itself possesses a thick, chitinlike wall. The heavy spicules seen in the terminal part of the vagina seem to act as a support for this structure, but their function is not clearly understood. From ob-

servations on a large series of these cestodes, it is concluded that once contact is established between the cirrus and vagina, separation may not often occur. Both intersegmental and interstrobilar copulation were recognized, and in the case of the latter, apparently as a result of manipulation when the worms were removed from the host, it was commonly seen that either the vagina or cirrus was torn completely free from the segment. This resulted in the two organs remaining tightly attached (Fig. 15).

This cestode was frequently observed in Oregon shrews and was one of the common species, along with *H. macyi* and *H. kenki*.

DISCUSSION

The description of the four species of cestodes here brings the total number of species recorded from North American shrews to 11. All the North American species are well characterized and can be readily differentiated. It would appear that the species of *Hymenolepis* parasitic in North American shrews have evolved quite separately from those found in the Eurasian mammals, since no Eurasian species has so far been recorded from North America. When more nearly complete information has been obtained there may be derived from it some understanding of the zoogeographically important implications which are involved.

SUMMARY

Seven species of cestodes have been recorded from Oregon shrews (*Sorex v. vagrans* Baird). Of these, *Protogynella blarinae* Jones, 1943, *Hymenolepis falculata* Rausch and Kuns, 1950, and *H. schilleri* Rausch and Kuns, 1950, are recorded here for the first time from the western part of North America. Four species of *Hymenolepis*, *H. macyi*, *H. kenki*, *H. sphenomorphus*, and *H. intricatus*, are described as new.

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ORNITHOLOGY.—*The long-tailed sugarbird of eastern Rhodesia.*[1] HERBERT FRIEDMANN, U. S. National Museum.

In his second paper on the birds of Gazaland, Swynnerton (Ibis, 1908: 31–32) recorded the Natal long-tailed sugarbird from the scrub-grown kloofs of the Melsetter District, extreme eastern Southern Rhodesia, and remarked that the bird was previously unknown north of the Limpopo, being recorded only from Natal, Swaziland, and the Transvaal. However, some eight years earlier Stark (*Fauna of South Africa, Birds*, **1,** 273. 1900) included Gazaland in the range of the species, although on what basis he did so is a mystery as there appear to be no published records prior to Swynnerton's. Indeed, several authors, such as Shelley and Reichenow, who refer to Stark's book, give the distribution of the species merely as Natal, Zululand, and the Transvaal, and either overlooked or doubted the stated occurrence in Gazaland. Since Swynnerton's day no notable extension of range has been reported for the bird in spite of very considerable work in eastern parts of the Union of South Africa, Southern Rhodesia, and Portuguese East Africa. It appears, then, that the bird has a very discontinuous range, which, in light of present knowledge, may be stated as from Pondoland in the eastern Cape Province, through Natal, Zululand, Swaziland, and the Drakensberg Mountains north to the Zoutpansberg area of the eastern Transvaal, and then again, after a long geographic gap of at least 200 miles of unsuitable

[1] Published by permission of the Secretary of the Smithsonian Institution. For the loan of specimens for study in the present connection I am indebted to the authorities of the American Museum of Natural History, the Chicago Natural History Museum, and the National Museum of Southern Rhodesia.

country, in the Melsetter District of Southern Rhodesia, near the Portuguese border.

Populations that are strikingly isolated geographically frequently reveal morphological characters worthy of nomenclatural recognition, and I was interested to examine and to compare Melsetter *Promerops* with others from eastern South Africa. When in Southern Rhodesia in 1950 I was able to acquire from Capt. Cecil D. Priest a number of birds he had obtained some years earlier in Gazaland, and among them was a fine adult male *Promerops*. Through the kindness of Reay H. N. Smithers, two additional examples (adult females) from Rocklands, in the Melsetter area, in the collections of the National Museum of Southern Rhodesia, have been made available to me for study. These three birds have been compared carefully with six examples of typical *gurneyi* from Natal and the northeastern Transvaal, and prove to represent a readily distinguishable race, which may be known as

Promerops cafer ardens, n. subsp.

Type.—U.S.N.M. no. 433386, ad. ♂, collected at Melsetter, Southern Rhodesia, May 13, 1939, by Cecil Damer Priest; orig. no. 290.

Subspecific character.—Similar to *Promerops cafer gurneyi*, but with the pectoral band conspicuously brighter and darker—between Hazel[2] and Mikado Brown, as opposed to Sayal Brown in *gurneyi*, with the rump and upper tail coverts less yellowish, more greenish—dusky Warbler Green as compared with Pyrite Yellow in *gurneyi*, with the upperparts generally darker, the centers of the feathers blacker—Chaetura Black (Fuscous in *gurneyi*), the cheeks darker—dusky Olive Brown (Drab in *gurneyi*), the tail feathers darker, the median ones more blackish below than in *gurneyi*, and the streaks on the sides and flanks are more blackish, less brownish than in the birds of the highlands of Natal and the northeastern Transvaal. An adult male from Woodbush, northeastern Transvaal, agrees with topotypical *gurneyi* from Natal in all the color characters. There seem to be no significant differences in dimensions between the two races, although not enough specimens have been available for measurement to be certain. The measurements of the type of *P. c. ardens* are wing 92, tail 170, culmen from the base 31.8, exposed culmen 26.2; tarsus 19.6 mm. The two females measure—wing 80, 88.2; tail 115+, 148+, culmen from the base 29, 29.7; exposed culmen 26, 27; tarsus 21, 22 mm.

[2] Capitalized color terms *ex* Ridgway, *Color standards and color nomenclature.*

Darrel C. H. Plowes, who knows the habitats of both the Natal-Transvaal race and the Melsetter form, has kindly supplied me with some pertinent facts about them. He tells me that in parts of Melsetter *Brachystegia* is the dominant tree with the *Proteas* being secondary, whereas in the Transvaal *Brachystegia* is absent. The ecological differences between the Transvaal section of the Drakensberg, and the Chimanimani Mountains in the Melsetter area have resulted in a number of endemic forms being found in the latter area, to which number the new *Promerops* is the latest addition.

Plowes noted *Promerops* was not uncommon around Melsetter village, though only rarely seen on the Martin Forest Reserve, an area of some 25,000 acres to the north and northeast. The birds were very common in the *Protea-Brachystegia-Phillipia* scrub on "Gwendingwe," some 15 miles to the east, and do not seem to stray far from this botanical complex.

There has been some discussion in the literature as to whether all the forms of *Promerops* are conspecific or if *cafer* is one species and *gurneyi* (with *ardens*) another species. It is true that *cafer* differs in having a very much longer tail and in lacking the rufous to a large extent on the crown, and, on the breast as well, but in habits the two groups are said to be alike, and geographically they do replace each other, i.e., they are representative forms. Final solution of this problem must wait until someone with adequate material from all parts of the range of the whole group and with sufficient data on their habits makes a comprehensive study. It is relatively seldom that one finds two closely related birds that show such marked morphological differentiation apparently unaccompanied by any differences in habit. The opposite condition—slight morphological differences coupled with considerable divergences in habit is much more frequent, as for example, in congeneric species of African pipits (*Anthus*) and grass warblers (*Cisticola*) or American tyrant flycatchers (*Empidonax*).

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